APPENDIX D
WASTE INVENTORIES

This appendix provides additional information about the inventories that drive the proposed alternatives described in Chapter 2 of this *Tank Closure and Waste Management Environmental Impact Statement for the Hanford Site, Richland, Washington (TC & WM EIS)*. Information provided in this appendix forms the basis for determining the short- and long-term environmental impacts under each alternative, which are described in Chapters 4 and 5, respectively, of this *TC & WM EIS*. Waste inventories supporting the cumulative impacts analysis are not included in Appendix D; they are provided in Appendix S, "Waste Inventories for Cumulative Impact Analyses." Each alternative represents a combination of technologies, processes, and facilities that could accomplish the desired outcome for that alternative. Distribution of the radioactive and chemical constituents of the tank waste among the various waste-form, storage, and management options depends on the technologies and processes used under each alternative. Information on the basis for the chemical and radionuclide composition (1) in the tanks, as well as on equipment and soils and in waste forms; (2) for the decommissioning of the Fast Flux Test Facility; and (3) for the waste management activities at the Hanford Site, including treatment, storage, and disposal of onsite and offsite waste, is provided in Sections D.1, D.2, and D.3, respectively. This information, along with data regarding the technologies and processes that would be used under each alternative, was used as a basis for modeling transport of contaminants in air, water, and soil.

D.1 TANK CLOSURE ALTERNATIVES

Beginning in 1944, the Federal Government irradiated uranium fuel in nuclear reactors at the Hanford Site (Hanford) to produce plutonium for national defense programs. Uranium and plutonium were recovered from the fuel using a variety of physical and chemical separations processes that generated highly radioactive waste streams. Between 1943 and 1964, the U.S. Department of Energy (DOE) commissioned 12 tank farms containing 149 single-shell tanks (SSTs) to store waste containing the radioactive and chemical constituents. During this time, programs were instituted to recover specific constituents and reduce stored volumes to accommodate production needs. During the 1950s, leakage from the tanks was confirmed. To address this leakage and provide safe storage of the waste, 28 double-shell tanks (DSTs) grouped in 6 additional tank farms were placed in service between 1971 and 1986. Because of the complexity of the production, processing, and waste management operations, the exact radiological and chemical characteristics of each tank are uncertain.

To support the *Tank Closure and Waste Management Environmental Impact Statement for the Hanford Site, Richland, Washington (TC & WM EIS)* environmental impact analyses, the amounts of radioactive and chemical constituents in the tanks and in leaks, discharges, and waste forms associated with tank operations, retrieval, and closure were estimated. Inventory estimates are presented in the following sections of this appendix:

- D.1.1, Current Tank Inventory of Radioactive and Chemical Constituents
- D.1.2, Tank Ancillary Equipment Waste
- D.1.3, Tank Residual Waste Inventories
- D.1.4, Historical Leaks and Other Releases
- D.1.5, Discharges to Cribs and Trenches (Ditches)
- D.1.6, Tank Waste Retrieval Leaks
- D.1.7, Inventories and Flowsheets
- D.1.8, Distribution of Radioactive Constituents of Potential Concern Under Tank Closure Alternatives

The primary sources of information related to tank inventories and past releases are summarized in the *Inventory and Source Term Data Package* (DOE 2003a), which was developed for this *TC & WM EIS*.

D.1.1 Current Tank Inventory of Radioactive and Chemical Constituents

Constituent concentrations are based on sample data, models, calculations, and engineering assessments. For tanks with no sample data, sample-based templates and engineering templates were used to estimate inventories based on data from tanks containing the same waste type. The estimation methods are summarized in the following paragraphs.

The Best-Basis Inventory (BBI) establishes the inventory of the underground waste storage tanks at Hanford by using sample data, process knowledge, surveillance data, and waste stream composition information from the HDW [Hanford Defined Waste] computer model (Agnew et al. 1997). The BBI is a process that was developed to more fully understand and use the available analytical data for tank samples and use the best available information to estimate tank compositions and inventories. The BBI provides the official estimate of SST and DST contents at Hanford for 24 chemical species and 46 radionuclides. The BBIs are updated on a quarterly basis to incorporate new data and waste transfer information. The BBI used in this environmental impact statement (EIS) reflects the inventory estimates for tank waste as of December 1, 2002. All radionuclides are decayed to January 1, 2001. Sample data that were released and waste transfers that occurred after December 1, 2002, are not included (DOE 2003a).

Sample data that represent the current contents of the tank are the preferred source of waste concentration information for the BBI (DOE 2003a). All of the DSTs and most of the SSTs have been sampled. However, a number of the sampled tanks were analyzed for a limited suite of analytes. In addition, the 23 SSTs listed in Table D–1 either were not sampled or their historical sample data are unusable. Among the 23 unsampled SSTs are 13 of the 18 tanks in the TX tank farm and 6 of the 15 tanks in the SX tank farm. Sampling is not required for retrieval and disposal planning purposes (Simpson, DeFigh-Price, and Banning 1999). Due to these limitations on collected samples, a complete tank inventory cannot be determined based on samples only.

Table D–1. Unsampled Single-Shell Tanks

241-B-105	241-BX-102	241-S-108
241-SX-107	241-SX-109	241-SX-110
241-SX-111	241-SX-112	241-SX-114
241-TX-101	241-TX-102	241-TX-103
241-TX-105	241-TX-106	241-TX-108
241-TX-109	241-TX-110	241-TX-111
241-TX-112	241-TX-114	241-TX-115
241-TX-117	241-U-104	

Source: DOE 2003a.

Process knowledge concentrations may be derived from information such as historical tank sample data, sample data from other tanks, waste transfers, and chemical additions. Waste-type template concentrations were used when other information was not available. The solid-waste-type templates were based on sample data for a particular waste type, supplemented with process knowledge and waste-type concentrations from the HDW model (Agnew et al. 1997). Liquid-waste-type templates were primarily based on waste-type concentrations from the HDW model, adjusted for process knowledge of mercury and other water-insoluble metals.

Most of the BBI chemical inventories can be traced to sample data or template concentrations based on samples. However, aside from radionuclides such as cesium-137 and its decay product barium-137m; strontium-90 and its decay product yttrium-90; and the isotopes of americium, curium, plutonium, and uranium; the BBI radionuclide inventories are largely based on the HDW model. This is especially true for the SSTs.

However, the BBI does not provide inventory estimates for analytes such as chromium, pertechnetate, polychlorinated biphenyls (PCBs), and volatile and semivolatile organic compounds that may be of concern for retrieval, disposal, and closure purposes. The procedures used to estimate inventories for these constituents are presented in Section D.1.1.3.

Selected tanks are being analyzed for PCBs. To date, 55 tanks have been sampled; 43 showed no PCBs and 12 had positive results for PCBs. These results were used to estimate an inventory across the tank farms. The procedures used to estimate PCB concentrations are presented in Section D.1.1.3.

The BBI includes quantity estimates of 46 radionuclides and 24 chemical constituents. Not all constituents are important in the exposure scenarios used to assess *TC & WM EIS* alternative implementation impacts. Thus, to focus attention on the constituents that control the impacts, DOE performed an initial screening analysis. For radionuclides, groundwater release and direct intrusion scenarios were considered. For the groundwater release screening scenario, only drinking water consumption was considered. Release was assumed to be partition limited, and decay during transport was considered. For the direct intrusion screening scenario, inadvertent soil ingestion and inhalation pathways were considered.

The analysis estimated relative impacts based on distribution of radionuclides in the BBI for all tanks. Radionuclides contributing less than 1 percent of impacts under intruder or well scenarios were eliminated from the detailed analysis. To screen for hazardous chemicals, drinking water ingestion impacts were estimated for the 24 BBI chemical constituents, and those contributing more than 99 percent of impacts were selected for detailed analysis. In addition, reported tank concentrations were reviewed and compared with health-based limits (DOE 2003a); chemical constituents of potential concern (COPCs), when compared with health-based limits (DOE 2003a), were added to the initial list of screened chemicals. The results of this analysis are presented in Table D–2. The screening of the BBI for the groundwater scenarios resulted in reduction of the original set of 46 radionuclides and 24 chemical constituents to a final set of 10 radionuclides and 10 chemical constituents that was used in the analysis of the tank waste. However, a screening of the cumulative impacts analysis data resulted in the addition of other COPCs that are not included in Table D–2. Appendix Q provides details on this screening. As noted in the footnote to Table D–2, americium-241 applies to the inhalation pathway for the intruder analysis scenarios analyzed in Appendix Q. Therefore, americium-241 inventory estimates are not included in Appendix D inventory tables since Appendix D tables apply to the EIS alternatives analysis.

Table D–2. Constituents Selected for Detailed Analysis

Radionuclides	Chemicals
Hydrogen-3 (tritium)	Chromium
Carbon-14	Mercury
Strontium-90[a]	Nitrate
Technetium-99	Lead
Iodine-129	Uranium
Cesium-137[a]	Acetonitrile
Uranium isotopes	Benzene
Neptunium-237	Butanol (n-butyl alcohol)
Plutonium isotopes	Polychlorinated biphenyls
Americium-241[b]	2,4,6-Trichlorophenol

[a] Daughter radionuclides for strontium-90 and cesium-137 (yttrium-90 and barium-137m, respectively) are not included; their dose contributions are either incorporated into dose estimates for the parent radionuclide or estimated to be minor.

[b] Applies to intruder analysis scenarios only through inhalation pathway.

D.1.1.1 Current Waste Phase Volume Inventories

This section summarizes the waste phase volumes in the SSTs and DSTs. There are four main waste phases used in the BBI: retained gas, salt cake, sludge, and supernatant. Salt cake and sludge are often further divided into solid and interstitial liquid phases. Except for retained gas, one or more waste types are associated with each waste phase. Waste types are associated with the waste streams that entered the tank farms from the separations plants or evaporators.

Information such as surveillance data (e.g., waste-surface-level, sludge-level, and liquid-observation-well measurements); in-tank photographs; core-sample extrusion observations; core-sample analyses (to distinguish between the salt cake and sludge waste phases); and waste transfer history were evaluated to determine the waste volumes used in the BBI. Interstitial liquid volumes were calculated using average porosities when no specific information was available for a tank. The volumes of tanks being stabilized by pumping of salt well liquids were estimated prior to the start of pumping and subsequently were adjusted to account for the volume of liquid removed from the tank.

BBI data, as presented in the *Inventory and Source Term Data Package*, provide the waste phase volumes for each tank, as well as a summary of the waste volumes by tank farm and totals for the SSTs and DSTs (DOE 2003a). Note that any retained gas in a tank was assumed to be trapped in the salt cake and sludge waste phases. Supernatant phases have not been found to contain significant quantities of retained gas (Mahoney et al. 1999). As a result, the total salt cake and sludge waste phase tank volume was greater than the values listed in the *Inventory and Source Term Data Package* for tanks containing retained gas (DOE 2003a).

Estimates of current waste volumes and individual tank design (nominal) volumes for each tank farm are presented in Table D–3. Current waste volumes and tank nominal volumes were used in conjunction with estimates of current tank inventories to develop inventory estimates of constituents in past leaks and tank waste retrieval leaks.

Table D–3. Tank Inventory Volumes

Tank Farm	Number of Tanks	Location	Nominal Volume of Tank Farms (cubic meters)	Current Volume of Waste[a] (cubic meters)
Single-Shell Tanks				
A	6	200-East Area	22,712	4,338
AX	4	200-East Area	15,142	2,097
B	16	200-East Area	24,908	7,743
BX	12	200-East Area	24,075	5,948
BY	12	200-East Area	34,432	15,789
C	16	200-East Area	24,908	6,653
S	12	200-West Area	34,432	19,777
SX	15	200-West Area	56,781	13,142
T	16	200-West Area	24,908	7,024
TX	18	200-West Area	51,648	24,568
TY	6	200-West Area	17,216	2,398
U	16	200-West Area	24,908	12,153
Total Single-Shell Tanks				**121,630**
Double-Shell Tanks				
AN	7	200-East Area	30,738	21,181
AP	8	200-East Area	35,129	27,828
AW	6	200-East Area	26,346	16,368
AY	2	200-East Area	7,571	3,257
AZ	2	200-East Area	7,571	7,548
SY	3	200-West Area	13,173	8,979
Total Double-Shell Tanks				**85,161**
Sum of All Tanks				**206,791**

[a] Volumes as of December 1, 2002.

Note: To convert cubic meters to gallons, multiply by 264.17.

Source: Derived from DOE 2003a, 2003b.

D.1.1.2 Radioactive Best-Basis Inventories

This section summarizes the BBI for each of the screened radioactive constituents in the SSTs and DSTs. The BBI provided the individual tank inventories and concentrations for each waste phase or type. The *Inventory and Source Term Data Package* (DOE 2003a) provided the inventory mass of all of the screened radioactive constituents estimated to be present at each tank farm as of December 1, 2002. Tables D–4 and D–5 summarize the screened radioactive constituent inventories for the SST and DST farms, respectively.

Table D–4. Single-Shell Tank Radioactive Constituent Inventories by Tank Farm (curies)

Analyte	Tank Farm												Total
	A	AX	B	BX	BY	C	S	SX	T	TX	TY	U	
Hydrogen-3 (tritium)	3.38×10^{2}	1.30×10^{2}	2.07×10^{1}	1.01×10^{2}	1.33×10^{3}	1.10×10^{2}	1.94×10^{3}	1.32×10^{3}	3.42×10^{1}	2.13×10^{3}	3.50×10^{1}	1.44×10^{3}	8.93×10^{3}
Carbon-14	8.33×10^{1}	6.44×10^{1}	7.88	4.19×10^{1}	5.60×10^{2}	1.58×10^{1}	5.05×10^{2}	2.90×10^{2}	1.48×10^{1}	6.47×10^{2}	7.63	3.56×10^{2}	2.59×10^{3}
Strontium-90	6.52×10^{6}	3.09×10^{6}	1.89×10^{6}	1.30×10^{6}	1.75×10^{6}	9.18×10^{6}	2.52×10^{6}	5.28×10^{6}	3.72×10^{5}	1.17×10^{6}	3.31×10^{5}	9.05×10^{5}	3.43×10^{7}
Technetium-99	6.74×10^{2}	4.13×10^{2}	2.13×10^{2}	3.70×10^{2}	2.54×10^{3}	3.51×10^{2}	2.74×10^{3}	1.76×10^{3}	1.63×10^{2}	3.76×10^{3}	1.02×10^{2}	2.43×10^{3}	1.55×10^{4}
Iodine-129	9.45×10^{-1}	4.81×10^{-1}	8.18×10^{-2}	4.49×10^{-1}	5.55	9.93×10^{-1}	5.93	3.35	1.14×10^{-1}	7.15	1.29×10^{-1}	4.69	2.99×10^{1}
Cesium-137	1.24×10^{6}	6.58×10^{5}	3.58×10^{5}	3.26×10^{5}	2.23×10^{6}	9.93×10^{5}	2.60×10^{6}	2.68×10^{6}	1.65×10^{5}	2.44×10^{6}	5.26×10^{4}	2.32×10^{6}	1.61×10^{7}
Uranium-233, -234, -235, -238	3.29×10^{1}	3.64	2.08×10^{1}	5.09×10^{1}	5.22×10^{1}	4.98×10^{2}	5.18×10^{1}	2.95×10^{1}	2.59×10^{1}	4.79×10^{1}	2.23×10^{1}	3.90×10^{1}	8.75×10^{2}
Neptunium-237	2.20	7.83×10^{-1}	3.38×10^{-1}	7.42×10^{-1}	8.59	5.72	1.12×10^{1}	6.71	2.78×10^{-1}	1.32×10^{1}	2.28×10^{-1}	8.94	5.89×10^{1}
Plutonium-239, -240	3.56×10^{3}	9.83×10^{2}	1.42×10^{3}	2.10×10^{3}	1.32×10^{3}	2.16×10^{4}	5.00×10^{3}	6.99×10^{3}	1.43×10^{3}	1.82×10^{4}	4.04×10^{2}	3.89×10^{3}	6.69×10^{4}

Source: DOE 2003a; SAIC 2011.

Table D–5. Double-Shell Tank Radioactive Constituent Inventories by Tank Farm (curies)

Analyte	Tank Farm						Total
	AN	AP	AW	AY	AZ	SY	
Hydrogen-3 (tritium)	1.18×10^{2}	1.53×10^{3}	1.70×10^{2}	2.47×10^{1}	1.87×10^{2}	1.09×10^{3}	3.12×10^{3}
Carbon-14	1.93×10^{2}	1.97×10^{2}	8.95×10^{1}	1.65	1.04×10^{1}	3.81×10^{1}	5.29×10^{2}
Strontium-90	1.05×10^{6}	5.20×10^{4}	2.89×10^{5}	6.66×10^{6}	7.95×10^{6}	2.18×10^{5}	1.62×10^{7}
Technetium-99	3.68×10^{3}	4.07×10^{3}	1.86×10^{3}	8.93×10^{1}	2.04×10^{3}	2.46×10^{3}	1.42×10^{4}
Iodine-129	3.81	7.69	2.11	1.42×10^{-1}	1.91	2.66	1.83×10^{1}
Cesium-137	8.46×10^{6}	5.36×10^{6}	3.26×10^{6}	2.89×10^{5}	9.84×10^{6}	2.58×10^{6}	2.98×10^{7}
Uranium-233, -234, -235, -238	7.88	2.85	3.93×10^{1}	3.20	5.67	4.50	6.34×10^{1}
Neptunium-237	8.17	1.43×10^{1}	2.39×10^{1}	5.03	2.70×10^{1}	3.80	8.22×10^{1}
Plutonium-239, -240	4.70×10^{2}	2.48×10^{1}	3.02×10^{3}	2.66×10^{3}	3.52×10^{3}	4.88×10^{3}	1.46×10^{4}

Source: DOE 2003a; SAIC 2011.

D.1.1.3 Nonradioactive Best-Basis Inventories

The BBI inventory mass for the screened nonradioactive constituents (chromium, mercury, nitrate, lead, and uranium) for each tank farm was provided by the HDW model. Available solid-, liquid-, and gas-phase concentration data were utilized to derive inventory estimates of five additional nonradioactive constituents identified during the screening procedure (DOE 2003a). The calculations and formulas used to estimate inventory masses for those additional constituents are described in the following paragraphs. Estimates of the current tank inventories for the 10 screened chemical constituents at the SST and DST farms are presented in Tables D–6 and D–7, respectively. Due to the reducing environment in the tanks, the nitrite inventory was converted on a molecular-weight basis and added to the nitrate inventory and reported as nitrate.

The volatile constituents acetonitrile, benzene, butanol (n-butyl alcohol), and 2,4,6-trichlorophenol were assumed to be present in the aqueous phase and therefore present in the DST farms. Due to the completion of interim stabilization activities in the SSTs, which removed the remaining secondary quantities of supernatant from the tanks, only small quantities of volatile constituents may be present in the SST farms; for analysis purposes, these small quantities were assumed to be zero. Nonvolatile constituents, such as PCBs, were assumed to be present in both the SST and DST farms.

Estimation of inventory mass for the five screened chemical constituents not included in the BBI used data for waste volume (see Table D–3) and waste phase; concentration of the gas, liquid, or solid phase; density of the phase; and mole fraction. The type of calculation conducted depended upon two factors: the waste phase and the tank farm.

For volatile, nonradioactive constituents with measured liquid-phase concentrations (benzene, 2,4,6-trichlorophenol), the inventory mass is equal to the product of the chemical concentration and the tank farm inventory volume, given in the following equation:

$$M_{BBITF} = \left[C_{\text{chemical}}\right] \times V_{BBITF} \times \zeta_m \times \zeta_v$$

where:

M_{BBITF} = inventory mass for each tank farm, grams

C_{chemical} = concentration of the benzene or 2,4,6-trichlorophenol, micrograms per milliliter

V_{BBITF} = inventory volume for each tank farm, liters

ζ_m = conversion constant, grams per microgram

ζ_v = conversion constant, milliliters per liter

Table D–6. Single-Shell Tank Nonradioactive Constituent Inventories by Tank Farm (kilograms)

Analyte	Tank Farm												Total
	A	AX	B	BX	BY	C	S	SX	T	TX	TY	U	
Chromium	1.62×10^{4}	7.87×10^{3}	1.11×10^{4}	2.20×10^{4}	7.34×10^{4}	5.60×10^{3}	1.20×10^{5}	1.05×10^{5}	1.21×10^{4}	6.13×10^{4}	7.95×10^{3}	5.11×10^{4}	4.95×10^{5}
Mercury	1.59×10^{2}	4.27×10^{1}	1.38×10^{2}	2.27×10^{2}	1.74×10^{2}	3.93×10^{2}	7.15×10^{1}	1.46×10^{2}	1.99×10^{1}	2.83×10^{1}	2.56×10^{2}	2.55×10^{1}	1.68×10^{3}
Nitrate	1.41×10^{6}	7.63×10^{5}	1.90×10^{6}	1.73×10^{6}	6.62×10^{6}	6.56×10^{5}	1.10×10^{7}	6.62×10^{6}	7.47×10^{5}	1.40×10^{7}	8.37×10^{5}	5.46×10^{6}	5.18×10^{7}
Lead	4.02×10^{3}	1.26×10^{3}	6.69×10^{3}	3.66×10^{3}	5.12×10^{3}	2.32×10^{4}	2.23×10^{3}	1.75×10^{3}	4.34×10^{3}	7.12×10^{3}	1.39×10^{3}	1.08×10^{4}	7.16×10^{4}
Uranium	1.10×10^{4}	1.48×10^{3}	2.86×10^{4}	7.35×10^{4}	6.55×10^{4}	1.13×10^{5}	5.19×10^{4}	3.27×10^{4}	3.72×10^{4}	4.56×10^{4}	3.24×10^{4}	4.97×10^{4}	5.42×10^{5}
Acetonitrile	0	0	0	0	0	0	0	0	0	0	0	0	0
Benzene	0	0	0	0	0	0	0	0	0	0	0	0	0
Butanol	0	0	0	0	0	0	0	0	0	0	0	0	0
PCBs	3.05×10^{1}	1.47×10^{1}	5.44×10^{1}	4.18×10^{1}	1.11×10^{2}	4.67×10^{1}	1.39×10^{2}	9.23×10^{1}	4.93×10^{1}	1.73×10^{2}	1.68×10^{1}	8.53×10^{1}	8.54×10^{2}
2,4,6-TCP	0	0	0	0	0	0	0	0	0	0	0	0	0

Note: To convert kilograms to pounds, multiply by 2.2046.
Key: butanol=n-butyl alcohol; PCB=polychlorinated biphenyl; TCP=trichlorophenol.
Source: DOE 2003a; SAIC 2011.

Table D–7. Double-Shell Tank Nonradioactive Constituent Inventories by Tank Farm (kilograms)

Analyte	Tank Farm						Total
	AN	AP	AW	AY	AZ	SY	
Chromium	1.85×10^{4}	1.03×10^{4}	1.99×10^{4}	2.79×10^{3}	5.09×10^{3}	4.73×10^{4}	1.04×10^{5}
Mercury	4.66	0	2.09×10^{-1}	1.26×10^{2}	4.15	8.95	1.44×10^{2}
Nitrate	6.47×10^{6}	5.65×10^{6}	3.47×10^{6}	1.70×10^{5}	7.74×10^{5}	2.48×10^{6}	1.90×10^{7}
Lead	3.63×10^{3}	9.01×10^{2}	1.51×10^{3}	4.48×10^{3}	4.03×10^{2}	1.57×10^{3}	1.25×10^{4}
Uranium	2.68×10^{3}	1.23×10^{3}	3.95×10^{4}	3.52×10^{3}	5.19×10^{3}	2.38×10^{3}	5.45×10^{4}
Acetonitrile	7.33×10^{3}	9.63×10^{3}	5.67×10^{3}	1.13×10^{3}	2.61×10^{3}	3.11×10^{3}	2.95×10^{4}
Benzene	5.97×10^{-1}	7.85×10^{-1}	4.62×10^{-1}	9.19×10^{-2}	2.13×10^{-1}	2.53×10^{-1}	2.40
Butanol (n-butyl alcohol)	8.59×10^{5}	1.13×10^{6}	6.63×10^{5}	1.32×10^{5}	3.06×10^{5}	3.64×10^{5}	3.45×10^{6}
Polychlorinated biphenyls	2.07×10^{2}	2.71×10^{2}	1.60×10^{2}	3.18×10^{1}	7.36×10^{1}	8.76×10^{1}	8.31×10^{2}
2,4,6-Trichlorophenol	2.75×10^{-1}	3.62×10^{-1}	2.13×10^{-1}	4.23×10^{-2}	9.81×10^{-2}	1.17×10^{-1}	1.11

Note: To convert kilograms to pounds, multiply by 2.2046.
Source: DOE 2003a; SAIC 2011.

For the volatile, nonradioactive constituents with measured vapor-phase concentrations (acetonitrile and butanol [n-butyl alcohol]), four calculations needed to be performed. First, the vaporization pressure was calculated using Antoine's equation. Second, the measured gas-phase concentration was converted to partial pressure using the ideal gas law. Next, Raoult's law was used to determine the molar fraction of the species in the liquid phase. The final calculation for determining the inventory mass was the product of the mole fraction and the ratio of the species' molar mass over the water molar mass times the tank farm inventory volume.

For the first step of the estimation procedure, the equilibrium partial pressure of the constituent was calculated using Antoine's equation:

$$\ell n P_{\text{vap}} = A - \frac{B}{T + C}$$

where:

P_{vap} = pressure of vaporization for the chemical, millimeters of mercury, at 25 degrees Celsius (ºC) (77 degrees Fahrenheit [ºF])

A,B,C = constants for each chemical (SAIC 2011)

T = temperature of the chemical after transfer to DST, assumed to be 298 kelvins

In the second step, the partial pressure of the constituent in the vapor phase was calculated using the ideal gas law:

$$P_{\text{partial}} = \lambda_P \times \frac{1}{\left(\lambda_V + \lambda_M\right)} \times \frac{\left[C_{\text{chemical}}\right] \times R \times T}{MW}$$

where:

P_{partial} = partial pressure of the chemical, millimeters of mercury

λ_P = conversion constant for pressure, 760 millimeters of mercury per atmosphere

λ_V = conversion constant for volume, 1,000 liters per cubic meter

λ_M = conversion constant for mass 1,000 milligrams per gram

C_{chemical} = concentration of acetonitrile or butanol (n-butyl alcohol), milligrams per cubic meter

R = gas constant, assumed to be 0.082 liter-atmospheres per mole-kelvin

T = temperature of the chemical, assumed to be 298 kelvins

MW = molecular weight of the chemical species, grams per mole

Next, Raoult's law was utilized to calculate the mole fraction of the constituent in the liquid phase through the following equation:

$$x = \frac{P_{\text{partial}}}{P_{\text{vap}}}$$

where:

x = mole fraction

P_{partial} = partial pressure of the chemical, millimeters of mercury

P_{vap} = pressure of vaporization for the chemical, millimeters of mercury

Finally, the mole fraction was converted to a mass fraction and used to calculate the inventory mass, using the following equation:

$$M_{BBITF} = x \times \frac{MW_{\text{species}}}{MW_{\text{H}_2\text{O}}} \times \rho_l \times V_{BBITF} \times 10^3$$

where:

M_{BBITF} = inventory mass for each tank farm, grams

x = mole fraction

MW_{species} = molecular weight of the chemical species, grams per mole

$MW_{\text{H}_2\text{O}}$ = molecular weight of water, grams per mole

ρ_l = density of the tank farm liquid, grams per cubic centimeter (SAIC 2011)

V_{BBITF} = inventory volume for each tank farm, liters

For nonvolatile, nonradioactive constituents (i.e., PCBs), the inventory masses are equivalent to the products of the phase concentration times the density of the phase times the tank farm inventory volume. Even though PCBs were not detected in some tanks in certain tank farms, the inventory data were spread across all of the tank farms to ensure the maximum mass was determined. PCBs have been detected in 12 of 55 tanks sampled. The average concentration of 14 solid-phase samples (DOE 2003a) is 7.80 micrograms per gram.

Using this average concentration and assuming that PCBs are present in all tanks, the inventory of each tank farm was estimated using the following equation:

$$M_{BBITF} = [C_{\text{chemical}}] \times \rho_s \times V_{BBITF} \times \varsigma_m \times \varsigma_v$$

where:

M_{BBITF} = inventory mass for each tank farm, grams

C_{chemical} = concentration of the PCBs, micrograms per gram

ρ_s = density of the solid, grams per cubic centimeter (SAIC 2011)

V_{BBITF} = inventory volume for each tank farm, liters

ς_m = conversion constant, grams per microgram

ς_v = conversion constant, cubic centimeters per liter

D.1.1.4 Uncertainty in Best-Basis Inventories

The BBI process follows protocols developed to combine differing types of measurements and estimates to produce the most reliable estimate of inventory. However, the high-level radioactive waste (HLW) tank inventory estimates contain considerable uncertainty regarding the number and quality of the available measurements and the estimation procedures that were used in the absence of measurements. As described in Section D.1.1, the HLW tank inventory estimates were based on waste composition and phase volume measurements, process knowledge calculations, and waste-type templates that were developed based on the sample data and model estimates (Field and Bowen 2003). Six types of waste phases were considered in developing these estimates: supernatant, salt cake solids, salt cake liquids, sludge solids, sludge liquids, and gas. Process knowledge calculations included correlation with a known constituent such as a parent radionuclide with a well-established ratio of parent-to-progeny concentration. The model-derived waste template estimates used in this *TC & WM EIS* were based on Revision 4 of the HDW model (Agnew et al. 1997). Sample analysis data provided the preferred bases for the estimates; calculated and template-based information were assigned lower priority. In each case, the inventory estimates were derived as the products of waste density, volume, and composition.

The uncertainty in the measurement-based estimation is due to the limited number of available samples, the complex nature of the tank contents, and the number of transfers and process activities used to manage the waste. The number of available samples is limited due to safety issues and the cost of obtaining them. Because waste phases are not uniform in nature and may be mixed to some extent, estimates of phase volumes and constituent concentrations are uncertain due to measurement and spatial variability. Processing and transfers designed to increase safety and optimize tank utilization produce additional variation among individual tanks. Estimating inventories using process modeling involves consideration of reactor fuel irradiation and chemical separations operations, as well as transfer and processing of tank contents. Incomplete knowledge of the degree of irradiation, process extraction and separations efficiencies, plant stream flow rates that affect recovery and distribution, and process losses to the environment all contribute to uncertainty in developing process modeling inventory estimates.

Quantitative estimates of inventory variability were expressed using the relative standard deviation (RSD), which is defined as the ratio of the standard deviation to the mean. RSD values were estimated from tank sample or sample-based template data. Sample-based templates are averages of samples taken from tanks whose contents are similar in composition to the contents of the tank for which samples are not available. The RSD values for density were reported as 5.9 and 8.2 percent for SST and DST liquids, respectively, and 7.6 and 6.5 percent for SST and DST solids, respectively (Field and Bowen 2003).

Because of the difficulty in determining the extent of phase volumes and in measuring volume, RSD values for volume were based on quantitative and qualitative information. Five data sources were used to estimate volume: surface-level, conductivity probe, sludge-level, liquid-observation well measurement, and core profiles. For the supernatant, salt cake, and sludge tanks, the average standard deviations of the surface-level readings were 0.64, 29.2, and 10.9 centimeters (0.25, 11.5, and 4.3 inches), corresponding to 2.6, 120, and 45 cubic meters (687; 31,700; and 11,888 gallons), respectively. The RSD for estimating volume was calculated as the standard deviation of the level divided by the total height of the waste in the tank. The mean concentration and its RSD were estimated for the constituents in each waste phase based on sample data. Estimates of concentration RSD based on sample data can range from 0 to 100 percent, while those based on waste-type templates can be much larger (Field and Bowen 2003). Median sample-based RSDs for the inventories in the SSTs and DSTs were calculated at 20 and 29 percent, respectively (DOE 2003a). Median template-based RSDs for inventories of SSTs and DSTs were calculated at 164 and 182 percent, respectively (DOE 2003a).

The above information on RSDs for density, volume, and concentration was combined to develop estimates of inventory RSDs for the individual constituents contained within each tank and at each tank farm (DOE 2003a). For four long-lived radionuclides that are important in determining groundwater impacts—technetium-99, iodine-129, uranium-238, and neptunium-237—RSDs for inventories at the tank farm level ranged from 70 to 231 percent, 44 to 231 percent, 77 to 453 percent, and 46 to 473 percent, respectively. Further quantitative estimates would require assumptions that cannot be fully tested using the current data. For example, regarding the assumption of normal data distribution, the 95th percentile upper confidence limit of the technetium-99 inventories in individual tank farms ranged from 2.2 to 5.6 times the BBI estimate across the 18 tank farms. For the combination of variances, the 95th percentile upper confidence limit of the total technetium-99 inventory was approximately 20 percent greater than the BBI estimate.

The above considerations indicate that greater uncertainty is involved in estimating the inventories of individual tanks and tank farms than in estimating total inventory, and greater uncertainty is associated with using template-based estimates than using sample-based estimates.

D.1.1.5 Best-Basis Inventory Comparison

As required by the *Technical Guidance Document for Tank Closure Environmental Impact Statement Vadose Zone and Groundwater Revised Analyses* (*Technical Guidance Document*) (DOE 2005), Table D–8 compares the radioactive and chemical COPCs for the December 2002 BBI estimate (DOE 2003a) with the October 2010 update to the BBI estimate. The October 2010 BBI update was the latest current update to the BBI available for review during the production of this final EIS. For comparison purposes, the table includes the radionuclides decayed to the same date, January 1, 2008.

The differences noted in Table D–8 are primarily due to the BBI Improvement Initiative, which was implemented after December 2002, and included the following:

- Updated the ORIGEN2 [Oak Ridge Isotope Generation and Depletion Code] (Croff 1980) fuel activity estimates
- Updated the HDW model to Revision 5, which accounted for a release of hydrogen-3 (tritium), carbon-14, and iodine-129 to the environment and shipment of offsite technetium-99 with uranium
- Updated the BBI templates with new sample data that added a second type of REDOX [Reduction-Oxidation] Facility waste to the SX tank farm, resulting in an increase in SX tank farm inventory

- Eliminated noncredible sample detection limit values from inventory estimates
- Incorporated new sample data, including iodine-129 analysis of BY tank farm salt cake (CEES 2011)

Table D–8. Best-Basis Inventory Comparison of Constituents of Potential Concern

	Column 1 December 2002 BBI, Decay Date: January 1, 2001	Column 2 December 2002 BBI, Decay Date: January 1, 2008	Column 3 October 2010 BBI, Decay Date: January 1, 2008	Percent Change from Decayed December 2002 BBI: (Column 3 – Column 2) /Column 2
Radionuclides	**Curies**	**Curies**	**Curies**	**Percent**
Americium-241	1.45×10^{5}	1.45×10^{5}	1.56×10^{5}	+7.6
Carbon-14	3.12×10^{3}	3.12×10^{3}	5.59×10^{2}	-82.1
Cesium-137	4.58×10^{7}	3.90×10^{7}	3.88×10^{7}	-0.5
Hydrogen-3 (tritium)	1.21×10^{4}	8.16×10^{3}	2.84×10^{3}	-65.2
Iodine-129	4.82×10^{1}	4.82×10^{1}	2.94×10^{1}	-39.0
Neptunium-237	1.41×10^{2}	1.41×10^{2}	1.19×10^{2}	-15.6
Plutonium-239, -240	8.14×10^{4}	8.14×10^{4}	5.95×10^{4}	-26.9
Strontium-90	5.05×10^{7}	4.27×10^{7}	4.76×10^{7}	+11.5
Technetium-99	2.97×10^{4}	2.97×10^{4}	2.64×10^{4}	-11.1
Uranium-233, -234, -235, -238	9.38×10^{2}	9.38×10^{2}	1.14×10^{3}	+21.7
Chemicals	**Kilograms**	**Kilograms**	**Kilograms**	**Percent**
Acetonitrile	NR	NR	NR	N/A
Benzene	NR	NR	NR	N/A
Butanol (n-butyl alcohol)	NR	NR	NR	N/A
Chromium	5.98×10^{5}	5.98×10^{5}	5.90×10^{5}	-1.3
Lead	8.41×10^{4}	8.41×10^{4}	8.27×10^{4}	-1.7
Mercury	1.83×10^{3}	1.83×10^{3}	1.99×10^{3}	+8.7
Nitrate[a]	7.09×10^{7}	7.09×10^{7}	7.14×10^{7}	+0.7
Uranium (total)	5.97×10^{5}	5.97×10^{5}	6.45×10^{5}	+8.0
Polychlorinated biphenyls	NR	NR	NR	N/A
2,4,6-Trichlorophenol	NR	NR	NR	N/A

[a] Nitrate values calculated as nitrate plus nitrite (oxidized).
Note: To convert kilograms to pounds, multiply by 2.2046.
Key: BBI=Best-Basis Inventory; N/A=not applicable; NR=not reported.
Source: CEES 2011; SAIC 2011.

Additional review of the uncertainty in the BBI estimate found the following:

- The uncertainties in the BBI estimate are important. The relative standard deviations derived for four key radionuclides (Section D.1.1.4) suggest that the inventories at the tank farm level (which form the basis for the alternatives' impacts analyses) support an uncertainty around the estimated inventory of approximately 50 to 400 percent.
- In general, the uncertainties for chemical constituents are lower than those for radionuclides. Inventories of chemical constituents are mostly sample-based, whereas radionuclide inventories rely to a greater degree on model calculations (e.g., the HDW model), engineering assessment, and the use of templates.

- A comparison of the uncertainties estimated for the BBI with another primary source of inventory data used in this EIS, SIM [the Hanford Soil Inventory Model] (Corbin et al. 2005), found similar estimates of uncertainties. Inventories of typical liquid waste streams disposed to the soil column in SIM are estimated to have variation around the mean of approximately 50 to 200 percent. The difference in the upper bounds (200 versus 400) is considered small when compared with the goal of this EIS of estimating impacts to an order of magnitude (10 times).

Additional review of the changes in the BBI estimates over an 8-year period between December 2002 and October 2010 found the following:

- All of the radionuclide COPC estimates, except those for americium-241, strontium-90, and uranium-233, -234, -235, and -238, have decreased since the 2002 BBI estimate was generated. The only radiological risk drivers in this grouping are the uranium isotopes.

- Only two chemical COPC estimates, nitrate and total uranium, have increased, with only total uranium a chemical hazard driver. All the other chemical constituents have decreased.

- Trend analysis of the data found consistency in both the increases and decreases in the estimates and within the uncertainties. Overall, their values have changed very little. For example, the largest decrease in the radiological risk drivers was that of iodine-129, at 65.2 percent. There were no decreases in chemical hazard drivers. The largest increases in the radiological risk drivers were those of uranium-233, -234, -235, and -238 (the dominant increase being in uranium-233), at 21.7 percent. The largest increase in chemical hazard drivers was that of total uranium, at 8.0 percent.

- Technetium-99 and iodine-129 values in the 2002 BBI are near the higher end of the range of values reported between December 2003 and October 2010. The range of values reported between December 2003 and October 2010 is consistent with the uncertainty estimates as well. Continued use of the 2002 BBI estimate for these radionuclides represents a degree of conservatism for key radionuclides, which is considered appropriate.

- Total uranium and uranium isotope values in the 2002 BBI are near the lower end of the ranged of values reported between December 2003 and October 2010. The range of values reported between December 2003 and October 2010 is smaller than the uncertainty itself. In addition, uranium (total) and uranium isotopes are more highly retained in soil and waste forms and less mobile in the environment, and their contribution to the long-term impacts analysis should be smaller than the contribution from the mobile radionuclides (i.e., technetium-99 and iodine-129).

In summary, DOE's decision to continue to use the 2002 BBI for tank waste inventory data in this EIS is based in part on the results of a 2005 review of the 2002 BBI estimates by the Washington State Department of Ecology (Ecology) and several DOE offices, i.e., Office of River Protection; Richland Operations Office; Office of Health, Safety, and Security; Office of Environmental Management; and Office of the General Counsel and in part on a review of the 8-year span of BBI data and uncertainty. The conclusion then, and now, is that the 2002 BBI is appropriate for the analyses in this *TC & WM EIS*. The above review of the BBI estimates from 2002 through 2010 supports this conclusion, as does Section 4.0, Assumptions, in the *Technical Guidance Document* (DOE 2005), dated March 25, 2005, which was approved by DOE and Ecology (SAIC 2011).

D.1.2 Tank Ancillary Equipment Waste

This section presents the estimated waste inventories contained in the ancillary facilities that are currently part of the SST and DST systems. Ancillary equipment includes miscellaneous underground storage tanks (MUSTs) (i.e., vaults); SST system tanks; DST system tanks; and the evaporators, evaporator tanks and vessels, pits, and transfer piping (DOE 2003a, 2003b) associated with the SST and DST farms.

Approximately one-half of the total waste volume estimate for ancillary equipment is credited to the MUSTs. Identification, dimensions, and locations of the MUSTs have been documented (DOE 2003a, 2003b). The reported capacities of the MUSTs range from 10 cubic meters (2,640 gallons) to 190 cubic meters (50,200 gallons) (DOE 2003b).

The pits include heel, pump, salt well, sluice, flush, and valve pits and diversion boxes. The SST farm volumes were derived by assuming a deposition of waste solids with an average thickness of only about 0.01 to 0.02 centimeters (0.004 to 0.008 inches) on the surfaces of the pits and piping (DOE 2003a). Waste volumes for the pits in the DST system were estimated by multiplying the waste volumes in the SST system pits by the ratio of DST system pit surface area to the SST system pit surface area. Waste volumes for the piping in the DST system were estimated in a similar manner. Volumes and surface areas were developed based on extrapolating information from detailed analyses of three SST farms and applying it to the other tank farms. DST void volumes in piping and structures were based on measurements of the six SSTs in the 241-A tank farm, which were then multiplied by a factor of 28/6 to obtain volumes for all 28 DSTs.

For analysis purposes, the volume of waste in the ancillary equipment for a given tank farm was calculated as the product of total waste volume in ancillary equipment for all tank farms times the number of tanks in a given tank farm, divided by the total number of tanks in the entire SST and DST system. Additionally, the concentration of each waste constituent in the ancillary equipment for a given tank farm was assumed to be the same as the average concentration of that constituent in the corresponding tank farm waste.

The inventories of radioactive and nonradioactive waste constituents in the ancillary equipment for a given tank farm were therefore calculated as the volume of waste in the ancillary equipment for that tank farm times the concentrations of each of those constituents in the waste currently stored in that tank farm. For example, the inventory of chromium in the ancillary equipment for the S tank farm was calculated as the volume of waste in the ancillary equipment for the S tank farm times the BBI mass of chromium in the S tank farm waste, divided by the volume of waste currently stored in the S tank farm. Radionuclide inventories were calculated similarly, with inventories and concentrations expressed in terms of curies rather than grams.

Volumes of ancillary equipment waste and quantities of individual constituents were estimated, respectively, as follows:

$$V_{\text{anc}} = \frac{V_{\text{anctot}}}{N_{\text{ttot}}} \times N_{\text{tanks}}$$

and

$$M_{\text{anc}} = \frac{M_{BBITF}}{V_{BBITF}} \times V_{\text{anc}}$$

where:

V_{anc} = ancillary equipment volume for each tank farm, liters

V_{anctot} = total ancillary equipment volume, liters

N_{ttot} = total number of tanks

N_{tanks} = number of tanks in tank farm

M_{anc} = waste inventory ancillary equipment for each tank farm, grams or curies

M_{BBITF} = waste inventory mass for each tank farm, grams or curies

V_{BBITF} = inventory volume for each tank farm, liters

Tables D–9 and D–10 represent the ancillary equipment waste radioactive and nonradioactive constituents for the SSTs, respectively. Tables D–11 and D–12 represent the ancillary equipment waste radioactive and nonradioactive constituents for the DSTs, respectively.

Table D–9. Single-Shell Tank Ancillary Equipment Radioactive Constituent Inventories (curies)

Analyte	Tank Farm												Total
	A	AX	B	BX	BY	C	S	SX	T	TX	TY	U	
H-3 (tritium)	2.74	1.46	2.51×10^{-1}	1.20	5.94	1.55	6.92	8.83	4.58×10^{-1}	9.16	5.14×10^{-1}	1.12×10^{1}	5.02×10^{1}
C-14	6.77×10^{-1}	7.21×10^{-1}	9.56×10^{-2}	4.96×10^{-1}	2.50	2.22×10^{-1}	1.80	1.94	1.98×10^{-1}	2.78	1.12×10^{-1}	2.75	1.43×10^{1}
Sr-90	5.29×10^{4}	3.46×10^{4}	2.29×10^{4}	1.54×10^{4}	7.82×10^{3}	1.29×10^{5}	8.98×10^{3}	3.54×10^{4}	4.98×10^{3}	5.02×10^{3}	4.86×10^{3}	6.99×10^{3}	3.29×10^{5}
Tc-99	5.47	4.63	2.59	4.38	1.13×10^{1}	4.95	9.76	1.18×10^{1}	2.18	1.62×10^{1}	1.50	1.88×10^{1}	9.35×10^{1}
I-129	7.67×10^{-3}	5.38×10^{-3}	9.92×10^{-4}	5.31×10^{-3}	2.47×10^{-2}	1.40×10^{-2}	2.11×10^{-2}	2.25×10^{-2}	1.52×10^{-3}	3.07×10^{-2}	1.89×10^{-3}	3.62×10^{-2}	1.72×10^{-1}
Cs-137	1.00×10^{4}	7.37×10^{3}	4.34×10^{3}	3.86×10^{3}	9.96×10^{3}	1.40×10^{4}	9.26×10^{3}	1.79×10^{4}	2.20×10^{3}	1.05×10^{4}	7.73×10^{2}	1.79×10^{4}	1.08×10^{5}
U-233, -234, -235, -238	2.67×10^{-1}	4.08×10^{-2}	2.53×10^{-1}	6.03×10^{-1}	2.33×10^{-1}	7.03	1.85×10^{-1}	1.98×10^{-1}	3.47×10^{-1}	2.06×10^{-1}	3.28×10^{-1}	3.01×10^{-1}	9.99
Np-237	1.78×10^{-2}	8.77×10^{-3}	4.10×10^{-3}	8.79×10^{-3}	3.83×10^{-2}	8.08×10^{-2}	3.99×10^{-2}	4.50×10^{-2}	3.72×10^{-3}	5.66×10^{-2}	3.35×10^{-3}	6.91×10^{-2}	3.76×10^{-1}
Pu-239, -240	2.89×10^{1}	1.10×10^{1}	1.72×10^{1}	2.49×10^{1}	5.87	3.04×10^{2}	1.78×10^{1}	4.68×10^{1}	1.92×10^{1}	7.82×10^{1}	5.94	3.01×10^{1}	5.90×10^{2}

Key: C=carbon; Cs=cesium; H=hydrogen; I=iodine; Np=neptunium; Pu=plutonium; Sr=strontium; Tc=technetium; U=uranium.
Source: SAIC 2011.

Table D–10. Single-Shell Tank Ancillary Equipment Nonradioactive Constituent Inventories (grams)

Analyte	Tank Farm												Total
	A	AX	B	BX	BY	C	S	SX	T	TX	TY	U	
Chromium	1.32×10^{5}	8.80×10^{4}	1.34×10^{5}	2.61×10^{5}	3.27×10^{5}	7.90×10^{4}	4.29×10^{5}	7.07×10^{5}	1.62×10^{5}	2.64×10^{5}	1.17×10^{5}	3.95×10^{5}	3.09×10^{6}
Mercury	1.29×10^{3}	4.78×10^{2}	1.68×10^{3}	2.69×10^{3}	7.74×10^{2}	5.55×10^{3}	2.55×10^{2}	9.80×10^{2}	2.66×10^{2}	1.22×10^{2}	3.76×10^{3}	1.97×10^{2}	1.80×10^{4}
Nitrate	1.15×10^{7}	8.55×10^{6}	2.30×10^{7}	2.04×10^{7}	2.95×10^{7}	9.25×10^{6}	3.93×10^{7}	4.44×10^{7}	9.98×10^{6}	6.02×10^{7}	1.23×10^{7}	4.22×10^{7}	3.11×10^{8}
Lead	3.26×10^{4}	1.41×10^{4}	8.12×10^{4}	4.34×10^{4}	2.28×10^{4}	3.27×10^{5}	7.96×10^{3}	1.17×10^{4}	5.80×10^{4}	3.06×10^{4}	2.04×10^{4}	8.37×10^{4}	7.34×10^{5}
Uranium	8.90×10^{4}	1.66×10^{4}	3.47×10^{5}	8.70×10^{5}	2.92×10^{5}	1.59×10^{6}	1.85×10^{5}	2.19×10^{5}	4.97×10^{5}	1.96×10^{5}	4.75×10^{5}	3.84×10^{5}	5.16×10^{6}
Acetonitrile	0	0	0	0	0	0	0	0	0	0	0	0	0
Benzene	0	0	0	0	0	0	0	0	0	0	0	0	0
Butanol	0	0	0	0	0	0	0	0	0	0	0	0	0
PCBs	2.47×10^{2}	1.65×10^{2}	6.59×10^{2}	4.95×10^{2}	4.95×10^{2}	6.59×10^{2}	4.95×10^{2}	6.18×10^{2}	6.59×10^{2}	7.42×10^{2}	2.47×10^{2}	6.59×10^{2}	6.14×10^{3}
2,4,6-TCP	0	0	0	0	0	0	0	0	0	0	0	0	0

Note: To convert grams to ounces, multiply by 0.03527.
Key: butanol=n-butyl alcohol; PCB=polychlorinated biphenyl; TCP=trichlorophenol.
Source: SAIC 2011.

Table D–11. Double-Shell Tank Ancillary Equipment Radioactive Constituent Inventories (curies)

Analyte	Tank Farm						Total
	AN	AP	AW	AY	AZ	SY	
Hydrogen-3 (tritium)	4.16×10^{-1}	4.70	6.64×10^{-1}	1.62×10^{-1}	5.30×10^{-1}	3.90	1.04×10^{1}
Carbon-14	6.80×10^{-1}	6.05×10^{-1}	3.50×10^{-1}	1.08×10^{-2}	2.93×10^{-2}	1.36×10^{-1}	1.81
Strontium-90	3.70×10^{3}	1.60×10^{2}	1.13×10^{3}	4.37×10^{4}	2.25×10^{4}	7.78×10^{2}	7.19×10^{4}
Technetium-99	1.30×10^{1}	1.25×10^{1}	7.28	5.86×10^{-1}	5.77	8.76	4.79×10^{1}
Iodine-129	1.35×10^{-2}	2.36×10^{-2}	8.24×10^{-3}	9.29×10^{-4}	5.40×10^{-3}	9.51×10^{-3}	6.11×10^{-2}
Cesium-137	2.98×10^{4}	1.65×10^{4}	1.28×10^{4}	1.89×10^{3}	2.78×10^{4}	9.20×10^{3}	9.80×10^{4}
Uranium-233, -234, -235, -238	2.78×10^{-2}	8.74×10^{-3}	1.54×10^{-1}	2.10×10^{-2}	1.60×10^{-2}	1.61×10^{-2}	2.43×10^{-1}
Neptunium-237	2.88×10^{-2}	4.40×10^{-2}	9.34×10^{-2}	3.30×10^{-2}	7.64×10^{-2}	1.36×10^{-2}	2.89×10^{-1}
Plutonium-239, -240	1.66	7.61×10^{-2}	1.18×10^{1}	1.75×10^{1}	9.97	1.74×10^{1}	5.84×10^{1}

Source: SAIC 2011.

Table D–12. Double-Shell Tank Ancillary Equipment Nonradioactive Constituent Inventories (grams)

Analyte	Tank Farm						Total
	AN	AP	AW	AY	AZ	SY	
Chromium	6.54×10^{4}	3.18×10^{4}	7.78×10^{4}	1.83×10^{4}	1.44×10^{4}	1.69×10^{5}	3.76×10^{5}
Mercury	1.64×10^{1}	0	8.18×10^{-1}	8.26×10^{2}	1.18×10^{1}	3.19×10^{1}	8.87×10^{2}
Nitrate	2.28×10^{7}	1.73×10^{7}	1.36×10^{7}	1.12×10^{6}	2.19×10^{6}	8.86×10^{6}	6.59×10^{7}
Lead	1.28×10^{4}	2.77×10^{3}	5.93×10^{3}	2.94×10^{4}	1.14×10^{3}	5.59×10^{3}	5.76×10^{4}
Uranium	9.46×10^{3}	3.78×10^{3}	1.55×10^{5}	2.31×10^{4}	1.47×10^{4}	8.51×10^{3}	2.14×10^{5}
Acetonitrile	2.59×10^{4}	2.96×10^{4}	2.22×10^{4}	7.39×10^{3}	7.39×10^{3}	1.11×10^{4}	1.04×10^{5}
Benzene	2.11	2.41	1.81	6.02×10^{-1}	6.02×10^{-1}	9.04×10^{-1}	8.43
Butanol (n-butyl alcohol)	3.03×10^{6}	3.46×10^{6}	2.60×10^{6}	8.66×10^{5}	8.66×10^{5}	1.30×10^{6}	1.21×10^{7}
Polychlorinated biphenyls	7.29×10^{2}	8.33×10^{2}	6.25×10^{2}	2.08×10^{2}	2.08×10^{2}	3.13×10^{2}	2.92×10^{3}
2,4,6-Trichlorophenol	9.72×10^{-1}	1.11	8.33×10^{-1}	2.78×10^{-1}	2.78×10^{-1}	4.17×10^{-1}	3.89

Note: To convert grams to ounces, multiply by 0.03527.
Source: SAIC 2011.

D.1.3 Tank Residual Waste Inventories

Residual waste is defined as the tank waste remaining in the tank after all waste retrieval actions have been completed. The Hanford Federal Facility Agreement and Consent Order, also known as the Tri-Party Agreement (TPA), allows approximately 10 cubic meters (360 cubic feet) of residual waste for 100-series SSTs and 0.8 cubic meters (30 cubic feet) of residual waste for 200-series SSTs following completion of retrieval operations; it also provides a method for determining the allowed residual waste in each tank on a tank-by-tank basis (Ecology, EPA, and DOE 1989). Three levels of retrieval were considered for the *TC & WM EIS* analysis: 90, 99, and 99.9 percent retrieval of the current inventory of radioactive and nonradioactive constituents. These retrieval percentages were developed to address various aspects related to retrieval levels or activities. Ninety percent retrieval represents a programmatic risk analysis of the tank farms as defined in the TPA Milestone M-45-00, Appendix H, process. Ninety-nine percent retrieval is the goal established in the TPA. The 99.9 percent retrieval rate applies to cases where tank removal was analyzed to limit worker exposure; this rate also reflects multiple uses of retrieval technologies.

This appendix describes three proposed methods for estimating residual waste in the storage tanks following retrieval and presents the results for the method selected (first method) for the *TC & WM EIS* analyses. The three methods are as follows:

1. The first method involves multiplying the existing total tank inventory by a ratio of the final waste volume to the current waste volume of a tank farm. Assume that the inventory is distributed uniformly through the volume of a tank farm. This method represents the case for waste retrieved "as is," i.e., without washing or leaching. For example, for 99 percent retrieval, the volume of SST residual waste in a tank farm would equal the current waste volume estimate in that tank farm, based on the 2002 BBI, multiplied by 0.01. This result may differ slightly from the TPA Milestone M-45-00, Appendix H, estimate, which used earlier tank volume estimates that were applied across all of the SSTs.

2. A more complex method involves making the following assumptions about which waste phases would remain in the tank following retrieval:

   - All supernatant would be removed, and retained gas would be released from the tank during retrieval.
   - Ten cubic meters (360 cubic feet) of waste would remain in a 100-series SST; 0.8 cubic meters (30 cubic feet) would remain in a 200-series SST.
   - Sludge would be at the bottom of the tank.
   - When a tank contains multiple sludge phases, each phase would remain in the tank in the same proportions that were present prior to retrieval.
   - For tanks where only salt cake exists, the remaining salt cake would be volumetrically proportional to the volumes currently in the tanks.
   - Tanks 241-TX-116 and 241-TX-117 are exceptions: all waste in these tanks would be removed in proportion to current volumes.
   - The fraction of each waste phase remaining (that is, the ratio of current phase volumes for each phase that would remain in the tank following retrieval) is calculated based on the assumptions above.
   - The final remaining constituent inventory (for each phase) is calculated from the initial inventory, current and final volume, and fraction of the phase.
   - The inventories for each phase are then added to get the tank total. This method is representative of dry retrieval by layer without mixing.

3. The third method uses output from the HTWOS [Hanford Tank Waste Operation Simulator] model (for radionuclides only) adjusted to the same final volume as the other two methods. This model applies component- and tank-specific water-wash factors and adds sufficient water to achieve either a 5-molar sodium solution or a 10 weight-percent slurry, whichever is the limiting condition for feed to the Waste Treatment Plant (WTP), to predict the composition of waste retrieved from the tank. Waste remaining in the tank after retrieval is assumed to have the same composition as the tank waste before retrieval (Kirkbride et al. 2002). This method is representative of sluicing-type waste retrieval methods.

Because the last two methods do not provide estimates for both radioactive and chemical constituents for each level of retrieval, the first method (volume retrieval) was applied. The degree of retrieval applicability across the Tank Closure alternatives is summarized in Table D–13. The inventory results of implementing the radioactive constituent procedure for the three retrieval cases are presented in Tables D–14 through D–19. The inventory results of implementing the chemical constituent procedure for the retrieval cases are presented in Tables D–20 through D–25.

Table D–13. Tank Closure Alternative Retrieval Approaches

Alternative	Approach
1	Best-Basis Inventory as salt cake for single-shell tanks, supernatant for double-shell tanks
2A	99 percent retrieval estimate; residual as salt cake for single-shell tanks and supernatant for double-shell tanks
2B, 3A, 3B, and 3C	99 percent retrieval estimate; residual stabilized with grout
4	99.9 percent retrieval estimate; residual stabilized with grout
5	90 percent retrieval estimate; residual stabilized with grout
6A and 6B	99.9 percent retrieval; tank and soil removed
6C	99 percent retrieval estimate; residual stabilized with grout

At the time of the preparation of this EIS, retrieval had been completed on seven SSTs, of which three were 100-series tanks and four were 200-series tanks. For the three 100-series tanks (C-103, C-106, and S-112), a review of the estimated residual technetium-99 inventory compared with the expected inventory found inconsistencies between the three tanks and a wide range in the ratio of final curies to expected curies. From this review, DOE concluded that it currently does not have a technical basis for making more-specific assumptions about the expected compositions of the waste "heels" that would remain in the tanks after retrieval, and not much is known about the behavior of, or ability to remove, small volumes of residual waste. It is also noted that the tank closure process, if implemented, would require detailed examination of the tanks and residual waste, as well as preparation of site-specific radiological performance assessments and closure plans. These documents will provide the information and analysis necessary for DOE and the regulators to make decisions on what levels of residual tank waste are acceptable in terms of short- and long-term risks.

Table D–14. Single-Shell Tank Residual Radioactive Constituent Inventories – 90 Percent Retrieval (curies)

Analyte	Tank Farm												Total
	A	AX	B	BX	BY	C	S	SX	T	TX	TY	U	
Hydrogen-3 (tritium)	3.38×10^{1}	1.30×10^{1}	2.07	1.01×10^{1}	1.33×10^{2}	1.10×10^{1}	1.94×10^{2}	1.32×10^{2}	3.42	2.13×10^{2}	3.50	1.44×10^{2}	8.93×10^{2}
Carbon-14	8.33	6.44	7.88×10^{-1}	4.19	5.60×10^{1}	1.58	5.05×10^{1}	2.90×10^{1}	1.48	6.47×10^{1}	7.63×10^{-1}	3.56×10^{1}	2.59×10^{2}
Strontium-90	6.52×10^{5}	3.09×10^{5}	1.89×10^{5}	1.30×10^{5}	1.75×10^{5}	9.18×10^{5}	2.52×10^{5}	5.28×10^{5}	3.72×10^{4}	1.17×10^{5}	3.31×10^{4}	9.05×10^{4}	3.43×10^{6}
Technetium-99	6.74×10^{1}	4.13×10^{1}	2.13×10^{1}	3.70×10^{1}	2.54×10^{2}	3.51×10^{1}	2.74×10^{2}	1.76×10^{2}	1.63×10^{1}	3.76×10^{2}	1.02×10^{1}	2.43×10^{2}	1.55×10^{3}
Iodine-129	9.45×10^{-2}	4.81×10^{-2}	8.18×10^{-3}	4.49×10^{-2}	5.55×10^{-1}	9.93×10^{-2}	5.93×10^{-1}	3.35×10^{-1}	1.14×10^{-2}	7.15×10^{-1}	1.29×10^{-2}	4.69×10^{-1}	2.99
Cesium-137	1.24×10^{5}	6.58×10^{4}	3.58×10^{4}	3.26×10^{4}	2.23×10^{5}	9.93×10^{4}	2.60×10^{5}	2.68×10^{5}	1.65×10^{4}	2.44×10^{5}	5.26×10^{3}	2.32×10^{5}	1.61×10^{6}
Uranium-233, -234, -235, -238	3.29	3.64×10^{-1}	2.08	5.09	5.22	4.98×10^{1}	5.18	2.95	2.59	4.79	2.23	3.90	8.75×10^{1}
Neptunium-237	2.20×10^{-1}	7.83×10^{-2}	3.38×10^{-2}	7.42×10^{-2}	8.59×10^{-1}	5.72×10^{-1}	1.12	6.71×10^{-1}	2.78×10^{-2}	1.32	2.28×10^{-2}	8.94×10^{-1}	5.89
Plutonium-239, -240	3.56×10^{2}	9.83×10^{1}	1.42×10^{2}	2.10×10^{2}	1.32×10^{2}	2.16×10^{3}	5.00×10^{2}	6.99×10^{2}	1.43×10^{2}	1.82×10^{3}	4.04×10^{1}	3.89×10^{2}	6.69×10^{3}

Source: DOE 2003a; SAIC 2011.

Table D–15. Double-Shell Tank Residual Radioactive Constituent Inventories – 90 Percent Retrieval (curies)

Analyte	Tank Farm						Total
	AN	AP	AW	AY	AZ	SY	
Hydrogen-3 (tritium)	1.18×10^{1}	1.53×10^{2}	1.70×10^{1}	2.47	1.87×10^{1}	1.09×10^{2}	3.12×10^{2}
Carbon-14	1.93×10^{1}	1.97×10^{1}	8.95	1.65×10^{-1}	1.04	3.81	5.29×10^{1}
Strontium-90	1.05×10^{5}	5.20×10^{3}	2.89×10^{4}	6.66×10^{5}	7.95×10^{5}	2.18×10^{4}	1.62×10^{6}
Technetium-99	3.68×10^{2}	4.07×10^{2}	1.86×10^{2}	8.93	2.04×10^{2}	2.46×10^{2}	1.42×10^{3}
Iodine-129	3.81×10^{-1}	7.69×10^{-1}	2.11×10^{-1}	1.42×10^{-2}	1.91×10^{-1}	2.66×10^{-1}	1.83
Cesium-137	8.46×10^{5}	5.36×10^{5}	3.26×10^{5}	2.89×10^{4}	9.84×10^{5}	2.58×10^{5}	2.98×10^{6}
Uranium-233, -234, -235, -238	7.88×10^{-1}	2.85×10^{-1}	3.93	3.20×10^{-1}	5.67×10^{-1}	4.50×10^{-1}	6.34
Neptunium-237	8.17×10^{-1}	1.43	2.39	5.03×10^{-1}	2.70	3.80×10^{-1}	8.22
Plutonium-239, -240	4.70×10^{1}	2.48	3.02×10^{2}	2.66×10^{2}	3.52×10^{2}	4.88×10^{2}	1.46×10^{3}

Source: DOE 2003a; SAIC 2011.

Table D–16. Single-Shell Tank Residual Radioactive Constituent Inventories – 99 Percent Retrieval (curies)

Analyte	Tank Farm												Total
	A	AX	B	BX	BY	C	S	SX	T	TX	TY	U	
Hydrogen-3 (tritium)	3.38	1.30	2.07×10^{-1}	1.01	1.33×10^{1}	1.10	1.94×10^{1}	1.32×10^{1}	3.42×10^{-1}	2.13×10^{1}	3.50×10^{-1}	1.44×10^{1}	8.93×10^{1}
Carbon-14	8.33×10^{-1}	6.44×10^{-1}	7.88×10^{-2}	4.19×10^{-1}	5.60	1.58×10^{-1}	5.05	2.90	1.48×10^{-1}	6.47	7.63×10^{-2}	3.56	2.59×10^{1}
Strontium-90	6.52×10^{4}	3.09×10^{4}	1.89×10^{4}	1.30×10^{4}	1.75×10^{4}	9.18×10^{4}	2.52×10^{4}	5.28×10^{4}	3.72×10^{3}	1.17×10^{4}	3.31×10^{3}	9.05×10^{3}	3.43×10^{5}
Technetium-99	6.74	4.13	2.13	3.70	2.54×10^{1}	3.51	2.74×10^{1}	1.76×10^{1}	1.63	3.76×10^{1}	1.02	2.43×10^{1}	1.55×10^{2}
Iodine-129	9.45×10^{-3}	4.81×10^{-3}	8.18×10^{-4}	4.49×10^{-3}	5.55×10^{-2}	9.93×10^{-3}	5.93×10^{-2}	3.35×10^{-2}	1.14×10^{-3}	7.15×10^{-2}	1.29×10^{-3}	4.69×10^{-2}	2.99×10^{-1}
Cesium-137	1.24×10^{4}	6.58×10^{3}	3.58×10^{3}	3.26×10^{3}	2.23×10^{4}	9.93×10^{3}	2.60×10^{4}	2.68×10^{4}	1.65×10^{3}	2.44×10^{4}	5.26×10^{2}	2.32×10^{4}	1.61×10^{5}
Uranium-233, -234, -235, -238	3.29×10^{-1}	3.64×10^{-2}	2.08×10^{-1}	5.09×10^{-1}	5.22×10^{-1}	4.98	5.18×10^{-1}	2.95×10^{-1}	2.59×10^{-1}	4.79×10^{-1}	2.23×10^{-1}	3.90×10^{-1}	8.75
Neptunium-237	2.20×10^{-2}	7.83×10^{-3}	3.38×10^{-3}	7.42×10^{-3}	8.59×10^{-2}	5.72×10^{-2}	1.12×10^{-1}	6.71×10^{-2}	2.78×10^{-3}	1.32×10^{-1}	2.28×10^{-3}	8.94×10^{-2}	5.89×10^{-1}
Plutonium-239, -240	3.56×10^{1}	9.83	1.42×10^{1}	2.10×10^{1}	1.32×10^{1}	2.16×10^{2}	5.00×10^{1}	6.99×10^{1}	1.43×10^{1}	1.82×10^{2}	4.04	3.89×10^{1}	6.69×10^{2}

Source: DOE 2003a; SAIC 2011.

Table D–17. Double-Shell Tank Residual Radioactive Constituent Inventories – 99 Percent Retrieval (curies)

Analyte	Tank Farm						Total
	AN	AP	AW	AY	AZ	SY	
Hydrogen-3 (tritium)	1.18	1.53×10^{1}	1.70	2.47×10^{-1}	1.87	1.09×10^{1}	3.12×10^{1}
Carbon-14	1.93	1.97	8.95×10^{-1}	1.65×10^{-2}	1.04×10^{-1}	3.81×10^{-1}	5.29
Strontium-90	1.05×10^{4}	5.20×10^{2}	2.89×10^{3}	6.66×10^{4}	7.95×10^{4}	2.18×10^{3}	1.62×10^{5}
Technetium-99	3.68×10^{1}	4.07×10^{1}	1.86×10^{1}	8.93×10^{-1}	2.04×10^{1}	2.46×10^{1}	1.42×10^{2}
Iodine-129	3.81×10^{-2}	7.69×10^{-2}	2.11×10^{-2}	1.42×10^{-3}	1.91×10^{-2}	2.66×10^{-2}	1.83×10^{-1}
Cesium-137	8.46×10^{4}	5.36×10^{4}	3.26×10^{4}	2.89×10^{3}	9.84×10^{4}	2.58×10^{4}	2.98×10^{5}
Uranium-233, -234, -235, -238	7.88×10^{-2}	2.85×10^{-2}	3.93×10^{-1}	3.20×10^{-2}	5.67×10^{-2}	4.50×10^{-2}	6.34×10^{-1}
Neptunium-237	8.17×10^{-2}	1.43×10^{-1}	2.39×10^{-1}	5.03×10^{-2}	2.70×10^{-1}	3.80×10^{-2}	8.22×10^{-1}
Plutonium-239, -240	4.70	2.48×10^{-1}	3.02×10^{1}	2.66×10^{1}	3.52×10^{1}	4.88×10^{1}	1.46×10^{2}

Source: DOE 2003a; SAIC 2011.

Table D–18. Single-Shell Tank Residual Radioactive Constituent Inventories – 99.9 Percent Retrieval (curies)

Analyte	Tank Farm												Total
	A	AX	B	BX	BY	C	S	SX	T	TX	TY	U	
Hydrogen-3 (tritium)	3.38×10^{-1}	1.30×10^{-1}	2.07×10^{-2}	1.01×10^{-1}	1.33	1.10×10^{-1}	1.94	1.32	3.42×10^{-2}	2.13	3.50×10^{-2}	1.44	8.93
Carbon-14	8.33×10^{-2}	6.44×10^{-2}	7.88×10^{-3}	4.19×10^{-2}	5.60×10^{-1}	1.58×10^{-2}	5.05×10^{-1}	2.90×10^{-1}	1.48×10^{-2}	6.47×10^{-1}	7.63×10^{-3}	3.56×10^{-1}	2.59
Strontium-90	6.52×10^{3}	3.09×10^{3}	1.89×10^{3}	1.30×10^{3}	1.75×10^{3}	9.18×10^{3}	2.52×10^{3}	5.28×10^{3}	3.72×10^{2}	1.17×10^{3}	3.31×10^{2}	9.05×10^{2}	3.43×10^{4}
Technetium-99	6.74×10^{-1}	4.13×10^{-1}	2.13×10^{-1}	3.70×10^{-1}	2.54	3.51×10^{-1}	2.74	1.76	1.63×10^{-1}	3.76	1.02×10^{-1}	2.43	1.55×10^{1}
Iodine-129	9.45×10^{-4}	4.81×10^{-4}	8.18×10^{-5}	4.49×10^{-4}	5.55×10^{-3}	9.93×10^{-4}	5.93×10^{-3}	3.35×10^{-3}	1.14×10^{-4}	7.15×10^{-3}	1.29×10^{-4}	4.69×10^{-3}	2.99×10^{-2}
Cesium-137	1.24×10^{3}	6.58×10^{2}	3.58×10^{2}	3.26×10^{2}	2.23×10^{3}	9.93×10^{2}	2.60×10^{3}	2.68×10^{3}	1.65×10^{2}	2.44×10^{3}	5.26×10^{1}	2.32×10^{3}	1.61×10^{4}
Uranium-233, -234, -235, -238	3.29×10^{-2}	3.64×10^{-3}	2.08×10^{-2}	5.09×10^{-2}	5.22×10^{-2}	4.98×10^{-1}	5.18×10^{-2}	2.95×10^{-2}	2.59×10^{-2}	4.79×10^{-2}	2.23×10^{-2}	3.90×10^{-2}	8.75×10^{-1}
Neptunium-237	2.20×10^{-3}	7.83×10^{-4}	3.38×10^{-4}	7.42×10^{-4}	8.59×10^{-3}	5.72×10^{-3}	1.12×10^{-2}	6.71×10^{-3}	2.78×10^{-4}	1.32×10^{-2}	2.28×10^{-4}	8.94×10^{-3}	5.89×10^{-2}
Plutonium-239, -240	3.56	9.83×10^{-1}	1.42	2.10	1.32	2.16×10^{1}	5.00	6.99	1.43	1.82×10^{1}	4.04×10^{-1}	3.89	6.69×10^{1}

Source: DOE 2003a; SAIC 2011.

Table D–19. Double-Shell Tank Residual Radioactive Constituent Inventories – 99.9 Percent Retrieval (curies)

Analyte	Tank Farm						Total
	AN	AP	AW	AY	AZ	SY	
Hydrogen-3 (tritium)	1.18×10^{-1}	1.53	1.70×10^{-1}	2.47×10^{-2}	1.87×10^{-1}	1.09	3.12
Carbon-14	1.93×10^{-1}	1.97×10^{-1}	8.95×10^{-2}	1.65×10^{-3}	1.04×10^{-2}	3.81×10^{-2}	5.29×10^{-1}
Strontium-90	1.05×10^{3}	5.20×10^{1}	2.89×10^{2}	6.66×10^{3}	7.95×10^{3}	2.18×10^{2}	1.62×10^{4}
Technetium-99	3.68	4.07	1.86	8.93×10^{-2}	2.04	2.46	1.42×10^{1}
Iodine-129	3.81×10^{-3}	7.69×10^{-3}	2.11×10^{-3}	1.42×10^{-4}	1.91×10^{-3}	2.66×10^{-3}	1.83×10^{-2}
Cesium-137	8.46×10^{3}	5.36×10^{3}	3.26×10^{3}	2.89×10^{2}	9.84×10^{3}	2.58×10^{3}	2.98×10^{4}
Uranium-233, -234, -235, -238	7.88×10^{-3}	2.85×10^{-3}	3.93×10^{-2}	3.20×10^{-3}	5.67×10^{-3}	4.50×10^{-3}	6.34×10^{-2}
Neptunium-237	8.17×10^{-3}	1.43×10^{-2}	2.39×10^{-2}	5.03×10^{-3}	2.70×10^{-2}	3.80×10^{-3}	8.22×10^{-2}
Plutonium-239, -240	4.70×10^{-1}	2.48×10^{-2}	3.02	2.66	3.52	4.88	1.46×10^{1}

Source: DOE 2003a; SAIC 2011.

Table D–20. Single-Shell Tank Residual Nonradioactive Constituent Inventories – 90 Percent Retrieval (grams)

Analyte	Tank Farm												Total
	A	AX	B	BX	BY	C	S	SX	T	TX	TY	U	
Chromium	1.62×10^{6}	7.87×10^{5}	1.11×10^{6}	2.20×10^{6}	7.34×10^{6}	5.60×10^{5}	1.20×10^{7}	1.05×10^{7}	1.21×10^{6}	6.13×10^{6}	7.95×10^{5}	5.11×10^{6}	4.95×10^{7}
Mercury	1.59×10^{4}	4.27×10^{3}	1.38×10^{4}	2.27×10^{4}	1.74×10^{4}	3.93×10^{4}	7.15×10^{3}	1.46×10^{4}	1.99×10^{3}	2.83×10^{3}	2.56×10^{4}	2.55×10^{3}	1.68×10^{5}
Nitrate	1.41×10^{8}	7.63×10^{7}	1.90×10^{8}	1.73×10^{8}	6.62×10^{8}	6.56×10^{7}	1.10×10^{9}	6.62×10^{8}	7.47×10^{7}	1.40×10^{9}	8.37×10^{7}	5.46×10^{8}	5.18×10^{9}
Lead	4.02×10^{5}	1.26×10^{5}	6.69×10^{5}	3.66×10^{5}	5.12×10^{5}	2.32×10^{6}	2.23×10^{5}	1.75×10^{5}	4.34×10^{5}	7.12×10^{5}	1.39×10^{5}	1.08×10^{6}	7.16×10^{6}
Uranium	1.10×10^{6}	1.48×10^{5}	2.86×10^{6}	7.35×10^{6}	6.55×10^{6}	1.13×10^{7}	5.19×10^{6}	3.27×10^{6}	3.72×10^{6}	4.56×10^{6}	3.24×10^{6}	4.97×10^{6}	5.42×10^{7}
Acetonitrile	0	0	0	0	0	0	0	0	0	0	0	0	0
Benzene	0	0	0	0	0	0	0	0	0	0	0	0	0
Butanol	0	0	0	0	0	0	0	0	0	0	0	0	0
PCBs	3.05×10^{3}	1.47×10^{3}	5.44×10^{3}	4.18×10^{3}	1.11×10^{4}	4.67×10^{3}	1.39×10^{4}	9.23×10^{3}	4.93×10^{3}	1.73×10^{4}	1.68×10^{3}	8.53×10^{3}	8.54×10^{4}
2,4,6-TCP	0	0	0	0	0	0	0	0	0	0	0	0	0

Note: To convert grams to ounces, multiply by 0.03527.
Key: butanol=n-butyl alcohol; PCB=polychlorinated biphenyl; TCP=trichlorophenol.
Source: DOE 2003a; SAIC 2011.

Table D–21. Double-Shell Tank Residual Nonradioactive Constituent Inventories – 90 Percent Retrieval (grams)

Analyte	Tank Farm						Total
	AN	AP	AW	AY	AZ	SY	
Chromium	1.85×10^{6}	1.03×10^{6}	1.99×10^{6}	2.79×10^{5}	5.09×10^{5}	4.73×10^{6}	1.04×10^{7}
Mercury	4.66×10^{2}	0	2.09×10^{1}	1.26×10^{4}	4.15×10^{2}	8.95×10^{2}	1.44×10^{4}
Nitrate	6.47×10^{8}	5.65×10^{8}	3.47×10^{8}	1.70×10^{7}	7.74×10^{7}	2.48×10^{8}	1.90×10^{9}
Lead	3.63×10^{5}	9.01×10^{4}	1.51×10^{5}	4.48×10^{5}	4.03×10^{4}	1.57×10^{5}	1.25×10^{6}
Uranium	2.68×10^{5}	1.23×10^{5}	3.95×10^{6}	3.52×10^{5}	5.19×10^{5}	2.38×10^{5}	5.45×10^{6}
Acetonitrile	7.33×10^{5}	9.63×10^{5}	5.67×10^{5}	1.13×10^{5}	2.61×10^{5}	3.11×10^{5}	2.95×10^{6}
Benzene	5.97×10^{1}	7.85×10^{1}	4.62×10^{1}	9.19	2.13×10^{1}	2.53×10^{1}	2.40×10^{2}
Butanol (n-butyl alcohol)	8.59×10^{7}	1.13×10^{8}	6.63×10^{7}	1.32×10^{7}	3.06×10^{7}	3.64×10^{7}	3.45×10^{8}
Polychlorinated biphenyls	2.07×10^{4}	2.71×10^{4}	1.60×10^{4}	3.18×10^{3}	7.36×10^{3}	8.76×10^{3}	8.31×10^{4}
2,4,6-Trichlorophenol	2.75×10^{1}	3.62×10^{1}	2.13×10^{1}	4.23	9.81	1.17×10^{1}	1.11×10^{2}

Note: To convert grams to ounces, multiply by 0.03527.
Source: DOE 2003a; SAIC 2011.

Table D–22. Single-Shell Tank Residual Nonradioactive Constituent Inventories – 99 Percent Retrieval (grams)

Analyte	Tank Farm												Total
	A	AX	B	BX	BY	C	S	SX	T	TX	TY	U	
Chromium	1.62×10^{5}	7.87×10^{4}	1.11×10^{5}	2.20×10^{5}	7.34×10^{5}	5.60×10^{4}	1.20×10^{6}	1.05×10^{6}	1.21×10^{5}	6.13×10^{5}	7.95×10^{4}	5.11×10^{5}	4.95×10^{6}
Mercury	1.59×10^{3}	4.27×10^{2}	1.38×10^{3}	2.27×10^{3}	1.74×10^{3}	3.93×10^{3}	7.15×10^{2}	1.46×10^{3}	1.99×10^{2}	2.83×10^{2}	2.56×10^{3}	2.55×10^{2}	1.68×10^{4}
Nitrate	1.41×10^{7}	7.63×10^{6}	1.90×10^{7}	1.73×10^{7}	6.62×10^{7}	6.56×10^{6}	1.10×10^{8}	6.62×10^{7}	7.47×10^{6}	1.40×10^{8}	8.37×10^{6}	5.46×10^{7}	5.18×10^{8}
Lead	4.02×10^{4}	1.26×10^{4}	6.69×10^{4}	3.66×10^{4}	5.12×10^{4}	2.32×10^{5}	2.23×10^{4}	1.75×10^{4}	4.34×10^{4}	7.12×10^{4}	1.39×10^{4}	1.08×10^{5}	7.16×10^{5}
Uranium	1.10×10^{5}	1.48×10^{4}	2.86×10^{5}	7.35×10^{5}	6.55×10^{5}	1.13×10^{6}	5.19×10^{5}	3.27×10^{5}	3.72×10^{5}	4.56×10^{5}	3.24×10^{5}	4.97×10^{5}	5.42×10^{6}
Acetonitrile	0	0	0	0	0	0	0	0	0	0	0	0	0
Benzene	0	0	0	0	0	0	0	0	0	0	0	0	0
Butanol	0	0	0	0	0	0	0	0	0	0	0	0	0
PCBs	3.05×10^{2}	1.47×10^{2}	5.44×10^{2}	4.18×10^{2}	1.11×10^{3}	4.67×10^{2}	1.39×10^{3}	9.23×10^{2}	4.93×10^{2}	1.73×10^{3}	1.68×10^{2}	8.53×10^{2}	8.54×10^{3}
2,4,6-TCP	0	0	0	0	0	0	0	0	0	0	0	0	0

Note: To convert grams to ounces, multiply by 0.03527.
Key: butanol=n-butyl alcohol; PCB=polychlorinated biphenyl; TCP=trichlorophenol.
Source: DOE 2003a; SAIC 2011.

Table D–23. Double-Shell Tank Residual Nonradioactive Constituent Inventories – 99 Percent Retrieval (grams)

Analyte	Tank Farm						Total
	AN	AP	AW	AY	AZ	SY	
Chromium	1.85×10^{5}	1.03×10^{5}	1.99×10^{5}	2.79×10^{4}	5.09×10^{4}	4.73×10^{5}	1.04×10^{6}
Mercury	4.66×10^{1}	0	2.09	1.26×10^{3}	4.15×10^{1}	8.95×10^{1}	1.44×10^{3}
Nitrate	6.47×10^{7}	5.65×10^{7}	3.47×10^{7}	1.70×10^{6}	7.74×10^{6}	2.48×10^{7}	1.90×10^{8}
Lead	3.63×10^{4}	9.01×10^{3}	1.51×10^{4}	4.48×10^{4}	4.03×10^{3}	1.57×10^{4}	1.25×10^{5}
Uranium	2.68×10^{4}	1.23×10^{4}	3.95×10^{5}	3.52×10^{4}	5.19×10^{4}	2.38×10^{4}	5.45×10^{5}
Acetonitrile	7.33×10^{4}	9.63×10^{4}	5.67×10^{4}	1.13×10^{4}	2.61×10^{4}	3.11×10^{4}	2.95×10^{5}
Benzene	5.97	7.85	4.62	9.19×10^{-1}	2.13	2.53	2.40×10^{1}
Butanol (n-butyl alcohol)	8.59×10^{6}	1.13×10^{7}	6.63×10^{6}	1.32×10^{6}	3.06×10^{6}	3.64×10^{6}	3.45×10^{7}
Polychlorinated biphenyls	2.07×10^{3}	2.71×10^{3}	1.60×10^{3}	3.18×10^{2}	7.36×10^{2}	8.76×10^{2}	8.31×10^{3}
2,4,6-Trichlorophenol	2.75	3.62	2.13	4.23×10^{-1}	9.81×10^{-1}	1.17	1.11×10^{1}

Note: To convert grams to ounces, multiply by 0.03527.
Source: DOE 2003a; SAIC 2011.

Table D–24. Single-Shell Tank Residual Nonradioactive Constituent Inventories – 99.9 Percent Retrieval (grams)

Analyte	Tank Farm												Total
	A	AX	B	BX	BY	C	S	SX	T	TX	TY	U	
Chromium	1.62×10^{4}	7.87×10^{3}	1.11×10^{4}	2.20×10^{4}	7.34×10^{4}	5.60×10^{3}	1.20×10^{5}	1.05×10^{5}	1.21×10^{4}	6.13×10^{4}	7.95×10^{3}	5.11×10^{4}	4.95×10^{5}
Mercury	1.59×10^{2}	4.27×10^{1}	1.38×10^{2}	2.27×10^{2}	1.74×10^{2}	3.93×10^{2}	7.15×10^{1}	1.46×10^{2}	1.99×10^{1}	2.83×10^{1}	2.56×10^{2}	2.55×10^{1}	1.68×10^{3}
Nitrate	1.41×10^{6}	7.63×10^{5}	1.90×10^{6}	1.73×10^{6}	6.62×10^{6}	6.56×10^{5}	1.10×10^{7}	6.62×10^{6}	7.47×10^{5}	1.40×10^{7}	8.37×10^{5}	5.46×10^{6}	5.18×10^{7}
Lead	4.02×10^{3}	1.26×10^{3}	6.69×10^{3}	3.66×10^{3}	5.12×10^{3}	2.32×10^{4}	2.23×10^{3}	1.75×10^{3}	4.34×10^{3}	7.12×10^{3}	1.39×10^{3}	1.08×10^{4}	7.16×10^{4}
Uranium	1.10×10^{4}	1.48×10^{3}	2.86×10^{4}	7.35×10^{4}	6.55×10^{4}	1.13×10^{5}	5.19×10^{4}	3.27×10^{4}	3.72×10^{4}	4.56×10^{4}	3.24×10^{4}	4.97×10^{4}	5.42×10^{5}
Acetonitrile	0	0	0	0	0	0	0	0	0	0	0	0	0
Benzene	0	0	0	0	0	0	0	0	0	0	0	0	0
Butanol	0	0	0	0	0	0	0	0	0	0	0	0	0
PCBs	3.05×10^{1}	1.47×10^{1}	5.44×10^{1}	4.18×10^{1}	1.11×10^{2}	4.67×10^{1}	1.39×10^{2}	9.23×10^{1}	4.93×10^{1}	1.73×10^{2}	1.68×10^{1}	8.53×10^{1}	8.54×10^{2}
2,4,6-TCP	0	0	0	0	0	0	0	0	0	0	0	0	0

Note: To convert grams to ounces, multiply by 0.03527.
Key: butanol=n-butyl alcohol; PCB=polychlorinated biphenyl; TCP=trichlorophenol.
Source: DOE 2003a; SAIC 2011.

Table D–25. Double-Shell Tank Residual Nonradioactive Constituent Inventories – 99.9 Percent Retrieval (grams)

Analyte	Tank Farm						Total
	AN	AP	AW	AY	AZ	SY	
Chromium	1.85×10^{4}	1.03×10^{4}	1.99×10^{4}	2.79×10^{3}	5.09×10^{3}	4.73×10^{4}	1.04×10^{5}
Mercury	4.66	0	2.09×10^{-1}	1.26×10^{2}	4.15	8.95	1.44×10^{2}
Nitrate	6.47×10^{6}	5.65×10^{6}	3.47×10^{6}	1.70×10^{5}	7.74×10^{5}	2.48×10^{6}	1.90×10^{7}
Lead	3.63×10^{3}	9.01×10^{2}	1.51×10^{3}	4.48×10^{3}	4.03×10^{2}	1.57×10^{3}	1.25×10^{4}
Uranium	2.68×10^{3}	1.23×10^{3}	3.95×10^{4}	3.52×10^{3}	5.19×10^{3}	2.38×10^{3}	5.45×10^{4}
Acetonitrile	7.33×10^{3}	9.63×10^{3}	5.67×10^{3}	1.13×10^{3}	2.61×10^{3}	3.11×10^{3}	2.95×10^{4}
Benzene	5.97×10^{-1}	7.85×10^{-1}	4.62×10^{-1}	9.19×10^{-2}	2.13×10^{-1}	2.53×10^{-1}	2.40
Butanol (n-butyl alcohol)	8.59×10^{5}	1.13×10^{6}	6.63×10^{5}	1.32×10^{5}	3.06×10^{5}	3.64×10^{5}	3.45×10^{6}
Polychlorinated biphenyls	2.07×10^{2}	2.71×10^{2}	1.60×10^{2}	3.18×10^{1}	7.36×10^{1}	8.76×10^{1}	8.31×10^{2}
2,4,6-Trichlorophenol	2.75×10^{-1}	3.62×10^{-1}	2.13×10^{-1}	4.23×10^{-2}	9.81×10^{-2}	1.17×10^{-1}	1.11

Note: To convert grams to ounces, multiply by 0.03527.
Source: DOE 2003a; SAIC 2011.

D.1.4 Historical Leaks and Other Releases

Leaks from SSTs have been suspected, investigated, and, in some cases, confirmed. Currently, 67 of Hanford's 149 SSTs are listed as "known or suspected" leakers in the monthly *Waste Tank Summary Report* (Hanlon 2003). This information was compiled in the late 1980s and early 1990s and reflects the state of knowledge at that time. The document contains information of varying quality. For example, leak volumes for tanks 241-SX-113, 241-SX-115, and 241-T-106 are well documented; however, for 19 of the tanks listed in the *Waste Tank Summary Report*, the leak volume estimates provided were based on limited supporting data. The leak volume estimates for the remaining 45 tanks are based on various methods and are further described in the *Waste Tank Summary Report*. Estimates of the total leak losses in the *Waste Tank Summary Report* range from 1.89 million to 3.97 million liters (0.5 million to 1.05 million gallons). Vadose zone field investigations have not been completed for all tank farms, and uncertainties remain regarding the estimated volumes of past leaks; the higher value of 3.97 million liters (1.05 million gallons) reported in the *Waste Tank Summary Report* was used for analysis purposes in this *TC & WM EIS*.

Current efforts to characterize impacts of leaks from the SSTs have focused on developing estimates of the inventories lost to the vadose zone. These efforts include gamma ray contamination detection mapping of the dry wells at the 12 SST farms using a gamma source and ongoing field investigations for four sets of tank farms. Using this information, estimates of inventories lost to the vadose zone have been developed. Analysis results for 20 tanks are documented in the *Inventory and Source Term Data Package* (DOE 2003a); the field investigation reports (CH2M HILL 2002; Connelly 2007, 2008; Jones et al. 2001; Myers 2005); and SIM [the Hanford Soil Inventory Model], Revision 1 (Corbin et al. 2005). This analysis constitutes the best available basis for estimating leak inventories from all SSTs suspected to be leaking. The approach used to extend the available information was to assume that the concentration in a leak from a tank in a given tank farm for which a documented estimate is not available is equal to the average concentration in leaks from tanks in the same tank farm for which documented estimates are available. For losses from the tank farms for which a documented inventory estimate is not available, i.e., the AX tank farm, tank volumes and times of operation were reviewed, and the tank farm was associated with a tank farm for which a documented inventory estimate is available. Thus, average concentrations from the AX tank farm were assumed to be equal to those of documented losses from the A tank farm. The inventory in a leak event was calculated as the product of the concentration in the leak and the leak volume. Results of this analysis are summarized in Tables D–26 through D–29, which present historical leaks (underground releases from the SSTs) and unplanned releases (at or near ground level at the SST farms) of radioactive and nonradioactive constituents from the tank farms.

Table D–26. Historical Single-Shell Tank Radioactive Constituent Leak Inventories (curies)

Analyte	Tank Farm												Total
	A	AX	B	BX	BY	C	S	SX	T	TX	TY	U	
H-3 (tritium)	8.28×10^{-2}	3.20×10^{-3}	1.52×10^{1}	1.09×10^{1}	3.13	1.23	7.12	9.61×10^{1}	5.33×10^{1}	1.08×10^{2}	2.56	6.44	3.04×10^{2}
C-14	1.13×10^{-1}	4.38×10^{-3}	3.10	5.17×10^{-1}	2.20×10^{-1}	1.46×10^{-1}	5.53×10^{-1}	4.79	9.52	1.50×10^{1}	3.40×10^{-1}	1.60×10^{-1}	3.45×10^{1}
Sr-90	2.69×10^{2}	1.04×10^{1}	7.61×10^{3}	4.13×10^{3}	1.49×10^{3}	2.63×10^{2}	4.52×10^{3}	2.29×10^{4}	2.43×10^{4}	5.73×10^{4}	3.17×10^{3}	5.79×10^{2}	1.27×10^{5}
Tc-99	1.24	4.80×10^{-2}	2.18×10^{1}	4.92	2.10	6.61	3.87	3.75×10^{1}	6.74×10^{1}	1.07×10^{2}	2.40	3.57	2.58×10^{2}
I-129	1.46×10^{-3}	5.64×10^{-5}	4.20×10^{-2}	9.35×10^{-3}	3.98×10^{-3}	2.59×10^{-3}	7.44×10^{-3}	7.10×10^{-2}	1.30×10^{-1}	2.06×10^{-1}	4.59×10^{-3}	4.50×10^{-3}	4.83×10^{-1}
Cs-137	4.62×10^{3}	1.78×10^{2}	2.64×10^{4}	4.22×10^{3}	1.54×10^{3}	1.82×10^{4}	1.14×10^{4}	1.26×10^{5}	2.49×10^{4}	1.58×10^{5}	5.64×10^{3}	8.57×10^{3}	3.90×10^{5}
U-233, -234, -235, -238	5.02×10^{-3}	1.94×10^{-4}	2.34×10^{-1}	7.16	3.06	5.41×10^{-3}	8.22×10^{-2}	4.20×10^{-1}	3.49×10^{-1}	3.16	1.33×10^{-1}	1.23×10^{-1}	1.47×10^{1}
Np-237	3.87×10^{-3}	1.50×10^{-4}	6.74×10^{-2}	2.64×10^{-2}	1.12×10^{-2}	2.29×10^{-2}	2.52×10^{-2}	1.65×10^{-1}	2.33×10^{-1}	3.86×10^{-1}	1.15×10^{-2}	2.13×10^{-2}	9.74×10^{-1}
Pu-239, -240	7.30×10^{-1}	2.82×10^{-2}	4.87	3.24	1.38	5.94×10^{-1}	1.64	8.23	1.28×10^{1}	2.87×10^{1}	1.78	1.39	6.54×10^{1}

Key: C=carbon; Cs=cesium; H=hydrogen; I=iodine; Np=neptunium; Pu=plutonium; Sr=strontium; Tc=technetium; U=uranium.
Source: SAIC 2011.

Table D–27. Historical Single-Shell Tank Nonradioactive Constituent Leak Inventories (grams)[a]

Analyte	Tank Farm												Total
	A	AX	B	BX	BY	C	S	SX	T	TX	TY	U	
Chromium	8.44×10^{3}	3.26×10^{2}	2.35×10^{5}	4.97×10^{4}	2.12×10^{4}	4.15×10^{4}	7.81×10^{5}	3.89×10^{6}	1.10×10^{6}	3.07×10^{6}	8.47×10^{4}	1.61×10^{5}	9.44×10^{6}
Mercury	1.74	6.72×10^{-2}	3.55×10^{2}	3.40×10^{1}	1.45×10^{1}	2.12×10^{1}	6.49×10^{1}	3.57×10^{1}	2.35×10^{2}	1.34×10^{3}	2.71×10^{1}	7.16×10^{1}	2.20×10^{3}
Nitrate	5.19×10^{5}	2.00×10^{4}	3.35×10^{7}	1.65×10^{7}	7.04×10^{6}	4.82×10^{6}	2.63×10^{7}	1.14×10^{8}	6.74×10^{7}	2.44×10^{8}	4.18×10^{7}	1.16×10^{7}	5.68×10^{8}
Lead	5.13×10^{2}	1.98×10^{1}	5.10×10^{4}	5.51×10^{3}	2.35×10^{3}	6.87×10^{3}	1.07×10^{4}	5.75×10^{4}	3.53×10^{4}	1.29×10^{5}	2.49×10^{3}	8.41×10^{2}	3.02×10^{5}
Uranium	4.52×10^{3}	1.74×10^{2}	2.44×10^{5}	1.06×10^{7}	4.52×10^{6}	2.88×10^{3}	1.19×10^{5}	5.52×10^{5}	3.82×10^{5}	1.30×10^{6}	1.04×10^{5}	1.81×10^{5}	1.80×10^{7}
Butanol	5.18×10^{2}	2.00×10^{1}	9.41×10^{4}	6.56×10^{3}	2.79×10^{3}	1.89×10^{4}	3.86×10^{-2}	6.37×10^{1}	3.78×10^{5}	6.13×10^{5}	9.40×10^{3}	1.77×10^{3}	1.13×10^{6}

[a] Acetonitrile, benzene, polychlorinated biphenyls, and 2,4,6-trichlorophenol not reported.
Note: To convert grams to ounces, multiply by 0.03527.
Key: butanol=n-butyl alcohol.
Source: SAIC 2011.

Table D–28. Single-Shell Tank Farms Unplanned Releases Radioactive Constituent Inventories (curies)

Analyte	Tank Farm												Total
	A	AX	B	BX	BY	C	S	SX	T	TX	TY	U	
H-3 (tritium)	N/A	N/A	4.58×10^{-1}	N/A	6.49×10^{-1}	2.32×10^{1}	N/A	N/A	N/A	5.88×10^{-2}	N/A	5.06×10^{-2}	2.44×10^{1}
C-14	N/A	N/A	7.84×10^{-2}	N/A	8.60×10^{-3}	1.89×10^{-1}	N/A	N/A	N/A	7.84×10^{-4}	N/A	8.58×10^{-4}	2.77×10^{-1}
Sr-90	N/A	N/A	5.50×10^{1}	N/A	7.13	1.07×10^{2}	N/A	N/A	N/A	6.88×10^{-1}	N/A	5.03	1.75×10^{2}
Tc-99	N/A	N/A	2.95	N/A	2.15×10^{-2}	1.67	N/A	N/A	N/A	2.01×10^{-3}	N/A	2.27×10^{-2}	4.67
I-129	N/A	N/A	1.77×10^{-3}	N/A	1.88×10^{-4}	2.48×10^{-2}	N/A	N/A	N/A	1.71×10^{-5}	N/A	2.53×10^{-5}	2.68×10^{-2}
Cs-137	N/A	N/A	3.44×10^{2}	N/A	4.87×10^{1}	8.55×10^{2}	N/A	N/A	N/A	4.59	N/A	5.18×10^{1}	1.30×10^{3}
U-233, -234, -235, -238	N/A	N/A	1.57×10^{-3}	N/A	2.22×10^{-3}	1.49×10^{-2}	N/A	N/A	N/A	2.02×10^{-4}	N/A	1.30×10^{-3}	2.02×10^{-2}
Np-237	N/A	N/A	9.69×10^{-3}	N/A	4.95×10^{-4}	5.57×10^{-3}	N/A	N/A	N/A	4.52×10^{-5}	N/A	1.31×10^{-4}	1.59×10^{-2}
Pu-239, -240	N/A	N/A	1.35×10^{-1}	N/A	5.98×10^{-3}	9.33×10^{-1}	N/A	N/A	N/A	6.53×10^{-4}	N/A	1.17×10^{-2}	1.09

Key: C=carbon; Cs=cesium; H=hydrogen; I=iodine; N/A=not applicable; Np=neptunium; Pu=plutonium; Sr=strontium; Tc=technetium; U=uranium.
Source: SAIC 2011.

Table D–29. Single-Shell Tank Farms Unplanned Releases Nonradioactive Constituent Inventories (grams)[a]

Analyte	Tank Farm												Total
	A	AX	B	BX	BY	C	S	SX	T	TX	TY	U	
Chromium	N/A	N/A	3.53×10^{4}	N/A	3.81×10^{4}	3.93×10^{4}	N/A	N/A	N/A	3.47×10^{3}	N/A	3.76×10^{2}	1.17×10^{5}
Mercury	N/A	N/A	8.40	N/A	3.45×10^{1}	3.92	N/A	N/A	N/A	3.13	N/A	6.14×10^{-1}	5.05×10^{1}
Nitrate	N/A	N/A	3.24×10^{6}	N/A	1.17×10^{7}	9.68×10^{6}	N/A	N/A	N/A	1.07×10^{6}	N/A	2.59×10^{4}	2.57×10^{7}
Lead	N/A	N/A	2.07×10^{3}	N/A	0.00	2.16×10^{4}	N/A	N/A	N/A	0.00	N/A	0.00	2.37×10^{4}
Uranium	N/A	N/A	1.81×10^{3}	N/A	3.30×10^{3}	4.64×10^{3}	N/A	N/A	N/A	2.99×10^{2}	N/A	1.93×10^{3}	1.20×10^{4}
Butanol	N/A	N/A	3.86×10^{-1}	N/A	0.00	6.47×10^{2}	N/A	N/A	N/A	1.15×10^{-2}	N/A	0.00	6.47×10^{2}

[a] Acetonitrile, benzene, polychlorinated biphenyls, and 2,4,6-trichlorophenol not reported.
Note: To convert grams to ounces, multiply by 0.03527.
Key: butanol=n-butyl alcohol; N/A=not applicable.
Source: SAIC 2011.

D.1.5 Discharges to Cribs and Trenches (Ditches)

During the early years of Hanford operations, three classes of liquid waste were produced during fuel reprocessing operations. Uncontaminated aqueous waste, such as cooling water, was discharged to surface ponds. High-volume waste streams with modest radioactive and chemical contamination were discharged to cribs and trenches (ditches). Waste streams that contained isotopes with long half-lives and fission products with high radiation/short half-lives were transferred to underground SSTs. Because many of the cribs and trenches (ditches) are in close proximity to the SST farms, in some cases it is very difficult to clearly identify contamination sources in the vadose zone or groundwater.

In parallel with the development of tank leak inventory estimates, inventory estimates were developed for intentional discharges of tank waste to cribs and trenches (ditches) near the B/BX/BY and T/TX/TY waste management areas (Simpson, Corbin, and Agnew 2001). The proximity of the cribs and trenches (ditches) to the tank farms warrants inclusion of these inventory estimates because they may be appropriate in tank farm vadose zone analyses. All volume and inventory estimates for discharges to cribs and trenches (ditches) were derived from SIM (Corbin et al. 2005).

SIM is an extension and enhancement of previous efforts to quantify contaminant inventories in the Hanford waste storage tanks. SIM provides more details of what went into specific waste sites other than the tanks than previously estimated and provides a more complete picture of these discharges. It is based on historical records and data from various Hanford process facilities that extracted plutonium and uranium from spent nuclear fuel (SNF). SIM generates inventory and uncertainty estimates for liquid waste disposal sites, unplanned releases, and tank leaks over the operating lifetimes in intervals of 1 year from 1944 to 2001 (Corbin et al. 2005).

Information on the vertical distribution of chemicals and radionuclides that were intentionally discharged to the soil column is available. A number of field investigations have examined the contaminant profile in a number of cribs. In general, the levels of contamination have varied, with the highest contaminant concentrations being associated with less-mobile radionuclides like cesium-137 and strontium-90 near the release points. Most mobile contaminants, such as tritium, technetium-99, and nitrate, are generally found in finer-grained materials at minor concentrations. Because of the high volumes of fluids discharged to the cribs, any contaminants that were not strongly sorbed by the soil were rapidly transferred to groundwater. Recent field investigations conducted by CH2M HILL Hanford Group at the 216-B-38 Trench (ditch) provide strong evidence that the trenches (ditches) functioned as designed. Soil analyses as a function of depth show the location of mobile constituents, such as nitrate, and sorbed species, such as cesium-137 and strontium-90 (DOE 2003a).

Estimates of volumes and inventories of radioactive and chemical constituents discharged to six sets of cribs and trenches (ditches) are presented in Tables D–30 and D–31. (Note: The T Trenches and TX Trenches are considered one set.) The grouping of the 33 cribs and trenches (ditches) provided in Tables D–30 and D–31 is as follows:

- T Cribs: 216-T-5, 216-T-7 (2)
- T Trenches: 216-T-14 through 216-T-19 (6)
- TX Trenches: 216-T-21 through 216-T-25 (5)
- TY Cribs: 216-T-26, 216-T-28, 216-T-32 (3)
- B Cribs: 216-B-7 A&B, 216-B-8 (2)
- BX Trenches: 216-B-35 through 216-B-42 (8)
- BY Cribs: 216-B-43 through 216-B-49 (7)

Table D–30. Radioactive Constituent Discharges to Cribs and Trenches (Ditches)

	T Cribs	T Trenches	TX Trenches	TY Cribs	B Cribs	BX Trenches	BY Cribs	Total
Volume discharged (liters)	1.10×10^{8}	4.60×10^{8}	8.02×10^{6}	8.24×10^{7}	7.99×10^{7}	1.49×10^{7}	3.38×10^{7}	7.89×10^{8}
Analyte (curies)								
Hydrogen-3 (tritium)	1.00×10^{-1}	5.15×10^{3}	4.89×10^{1}	2.95	2.10×10^{-2}	9.09×10^{1}	2.11×10^{2}	5.50×10^{3}
Carbon-14	3.98×10^{-1}	5.94×10^{-1}	6.48×10^{-1}	3.80	1.71×10^{-1}	1.44	8.17	1.52×10^{1}
Strontium-90	3.96×10^{2}	3.41×10^{2}	5.77×10^{2}	5.80×10^{2}	1.78×10^{3}	1.16×10^{3}	4.74×10^{3}	9.57×10^{3}
Technetium-99	2.05×10^{-1}	9.41×10^{-1}	1.62	1.80	1.75×10^{-1}	8.40	1.28×10^{2}	1.42×10^{2}
Iodine-129	1.49×10^{-5}	8.28×10^{-3}	1.41×10^{-2}	1.70×10^{-2}	6.94×10^{-4}	3.09×10^{-2}	1.65×10^{-1}	2.36×10^{-1}
Cesium-137	4.60×10^{2}	1.82×10^{3}	3.67×10^{3}	6.30×10^{2}	5.42×10^{2}	6.17×10^{3}	1.62×10^{3}	1.49×10^{4}
Uranium-233, -234, -235, -238	2.45×10^{-1}	1.35×10^{-1}	1.85×10^{-1}	3.00	1.58	3.40×10^{-1}	7.17×10^{-1}	6.21
Neptunium-237	1.10×10^{-1}	2.60×10^{-2}	3.73×10^{-2}	8.01×10^{-2}	5.12×10^{-2}	1.07×10^{-1}	1.02	1.43
Plutonium-239, -240	2.81×10^{2}	1.47×10^{1}	3.71	9.45×10^{1}	1.64×10^{2}	6.96	2.82×10^{1}	5.94×10^{2}

Note: To convert liters to gallons, multiply by 0.26417.
Source: SAIC 2011.

Table D–31. Nonradioactive Constituent Discharges to Cribs and Trenches (Ditches)[a]

	T Cribs	T Trenches	TX Trenches	TY Cribs	B Cribs	BX Trenches	BY Cribs	Total
Volume discharged (liters)	1.10×10^{8}	4.60×10^{8}	8.02×10^{6}	8.24×10^{7}	7.99×10^{7}	1.49×10^{7}	3.38×10^{7}	7.89×10^{8}
Analyte (kilograms)								
Chromium	2.93×10^{4}	2.61×10^{3}	2.87×10^{3}	1.75×10^{4}	1.79×10^{4}	5.05×10^{3}	5.82×10^{3}	8.09×10^{4}
Mercury	0	6.13	2.86	8.19	1.23×10^{-2}	5.26	1.09×10^{1}	3.33×10^{1}
Nitrate	6.79×10^{6}	8.13×10^{5}	1.04×10^{6}	3.17×10^{6}	4.65×10^{6}	1.77×10^{6}	6.72×10^{6}	2.50×10^{7}
Lead	0	5.50	0	1.46×10^{1}	7.69	0	0	2.78×10^{1}
Uranium	3.63×10^{2}	2.00×10^{2}	2.74×10^{2}	1.11×10^{3}	3.88×10^{2}	5.04×10^{2}	1.06×10^{3}	3.90×10^{3}

[a] Acetonitrile, benzene, polychlorinated biphenyls, and 2,4,6-trichlorophenol not reported.
Note: To convert kilograms to pounds, multiply by 2.2046; liters to gallons, by 0.26417.
Source: SAIC 2011.

D.1.6 Tank Waste Retrieval Leaks

The amount of leakage that may occur during retrieval of waste from SSTs varies with the details of the individual tank condition and retrieval methods and is largely uncertain. During actual retrieval operations, leak detection and monitoring would be used to minimize leakage to the extent practicable.

The SSTs were constructed as early as 1943. Currently, 67 of Hanford's 149 SSTs are listed as "known or suspected" leakers. The SSTs were formally removed from service in 1980, but still contain approximately 120 million liters (32 million gallons) of waste. Although the River Protection Project plans to minimize the introduction of liquids into suspected leakers (utilizing vacuum-based retrieval), for analysis purposes, all SSTs were assumed to leak during retrieval. The *Tank Waste Remediation System, Hanford Site, Richland, Washington, Final Environmental Impact Statement* (DOE and Ecology 1996) assumed an average of 15,140 liters (4,000 gallons) would leak during SST retrieval. Due to limitations on currently employed leak detection equipment, this assumption was carried forward in this EIS. The leak detection monitoring and mitigation strategy developed for the tank 241-S-112 retrieval demonstration (Hanson 2003) estimated that the best of the three available leak detection methods utilized gamma ray contamination detection mapping of the dry wells and neutron contamination detection mapping of the soil. The 95th percentile upper confidence limit with this method estimated leak detection within a leak volume ranging from 1,140 to 68,000 liters (300 to 18,000 gallons), depending on where the

leak originated in relation to the dry wells. In-tank liquid-balance leak detection methods were even less sensitive, ranging from 68,000 to 310,000 liters (18,000 to 82,000 gallons) at the 95th percentile upper confidence limit. Technologies to assist in mitigation and improve detection of leakage are currently being evaluated and tested by the River Protection Project. Testing conducted on resistivity-based technologies over a 110-day period in 2003 at the Hanford 105A mock-tank test site provided encouraging data for the potential future use of much more sensitive leak detection capabilities (Barnett et al. 2003). High-resolution resistivity has been used on a number of SSTs starting in 2004. See Appendix E, Section E.1.2.2.5.1, for further details.

In addition to leak volume specification, estimating the inventory of each constituent released to the vadose zone requires knowledge of the retrieval method used and the tank inventories addressed during retrieval operations. Retrieval operations that may result in leakage are those that use liquid to sluice salt cake and sludge from the SSTs. Current analysis projects that three volumes of sluicing liquid would remove one volume of SST solids (DOE 2003b). A conservative estimate of the inventory present in the tank during retrieval is provided by the estimate of current tank inventories. These estimates are summarized in Section D.1.1. Given these considerations, the concentration of a constituent in leak liquid would be one-quarter of the volumetric concentration of the constituent in the tank prior to retrieval. For a single tank, the loss of a constituent in leakage during retrieval is estimated using the following equation:

$$M_{\text{retrieval}} = \frac{M_{BBIT}}{V_{BBIT}} \times \frac{1}{4} \times V_{rb}$$

where:

$M_{\text{retrieval}}$ = amount of the radioactive or chemical constituent in tank waste retrieval leaks for a tank, curies or grams

M_{BBIT} = inventory of constituent in the tank, curies or grams

V_{BBIT} = inventory volume in the tank, liters

V_{rb} = volume lost during retrieval, 15,140 liters (4,000 gallons)

The constituent loss estimates for all tank farms were calculated as the sum of the losses from the individual tanks in the tank farm. Estimated retrieval losses of radioactive and chemical constituents on a tank-farm basis are presented in Tables D–32 and D–33.

Table D–32. Single-Shell Tank Radioactive Constituent Tank Waste Retrieval Leak Inventories (curies)

Analyte	Tank Farm												Total
	A	AX	B	BX	BY	C	S	SX	T	TX	TY	U	
H-3 (tritium)	2.10	1.75	3.22×10^{-1}	5.30×10^{-1}	3.78	5.56×10^{-1}	4.39	4.33	4.66×10^{-1}	5.86	3.59×10^{-1}	4.20	2.86×10^{1}
C-14	4.85×10^{-1}	6.15×10^{-1}	8.93×10^{-2}	2.23×10^{-1}	1.59	1.02×10^{-1}	1.15	7.71×10^{-1}	2.97×10^{-1}	1.71	8.03×10^{-2}	1.02	8.13
Sr-90	1.83×10^{5}	3.11×10^{5}	1.47×10^{4}	1.71×10^{4}	5.13×10^{3}	6.95×10^{4}	6.33×10^{3}	1.35×10^{5}	7.15×10^{3}	6.78×10^{3}	2.56×10^{3}	8.58×10^{3}	7.68×10^{5}
Tc-99	5.06	1.48×10^{1}	1.26	2.31	7.46	2.72	6.36	5.55	1.71	1.01×10^{1}	1.36	6.97	6.57×10^{1}
I-129	7.38×10^{-3}	6.54×10^{-3}	9.81×10^{-4}	2.48×10^{-3}	1.57×10^{-2}	4.85×10^{-3}	1.35×10^{-2}	9.27×10^{-3}	1.59×10^{-3}	1.92×10^{-2}	9.23×10^{-4}	1.33×10^{-2}	9.58×10^{-2}
Cs-137	9.37×10^{3}	1.07×10^{4}	2.05×10^{3}	2.60×10^{3}	6.24×10^{3}	1.01×10^{4}	6.14×10^{3}	1.03×10^{4}	1.75×10^{3}	7.61×10^{3}	6.27×10^{2}	8.29×10^{3}	7.57×10^{4}
U-233, -234, -235, -238	5.43×10^{-1}	3.15×10^{-2}	1.58×10^{-1}	5.00×10^{-1}	1.55×10^{-1}	2.18	1.31×10^{-1}	1.83×10^{-1}	1.95×10^{-1}	1.56×10^{-1}	2.21×10^{-1}	1.84×10^{-1}	4.64
Np-237	1.24×10^{-2}	8.43×10^{-3}	2.62×10^{-3}	3.94×10^{-3}	2.52×10^{-2}	3.42×10^{-2}	2.55×10^{-2}	1.96×10^{-2}	4.92×10^{-3}	3.56×10^{-2}	2.33×10^{-3}	2.59×10^{-2}	2.01×10^{-1}
Pu-239, -240	7.47×10^{1}	5.70×10^{1}	1.52×10^{1}	2.53×10^{1}	3.67	2.21×10^{2}	1.29×10^{1}	1.74×10^{2}	2.01×10^{1}	7.47×10^{1}	3.83	1.45×10^{1}	6.97×10^{2}

Key: C=carbon; Cs=cesium; H=hydrogen; I=iodine; Np=neptunium; Pu=plutonium; Sr=strontium; Tc=technetium; U=uranium.
Source: SAIC 2011.

Table D–33. Single-Shell Tank Nonradioactive Constituent Tank Waste Retrieval Leak Inventories (kilograms)

Analyte	Tank Farm												Total
	A	AX	B	BX	BY	C	S	SX	T	TX	TY	U	
Chromium	1.19×10^{2}	4.39×10^{1}	1.20×10^{2}	2.31×10^{2}	2.29×10^{2}	4.15×10^{1}	2.73×10^{2}	4.21×10^{2}	1.38×10^{2}	2.05×10^{2}	7.17×10^{1}	1.92×10^{2}	2.08×10^{3}
Mercury	4.02	2.54	1.18	2.71	4.93×10^{-1}	2.44	1.73×10^{-1}	1.20	1.37×10^{-1}	2.53×10^{-1}	1.57	3.32×10^{-1}	1.70×10^{1}
Nitrate	5.53×10^{3}	1.02×10^{5}	7.29×10^{4}	2.89×10^{4}	1.55×10^{4}	9.53×10^{4}	2.40×10^{4}	5.35×10^{4}	6.19×10^{4}	3.74×10^{4}	7.84×10^{3}	9.72×10^{4}	6.02×10^{5}
Lead	8.21×10^{1}	6.98×10^{1}	4.42×10^{1}	4.26×10^{1}	1.47×10^{1}	3.33×10^{3}	5.05	7.89	4.96×10^{1}	1.90×10^{1}	1.28×10^{1}	9.86×10^{1}	3.77×10^{3}
Uranium	1.79×10^{2}	2.93×10^{1}	2.15×10^{2}	7.25×10^{2}	1.95×10^{2}	8.04×10^{2}	1.35×10^{2}	2.40×10^{2}	2.79×10^{2}	1.59×10^{2}	3.23×10^{2}	2.50×10^{2}	3.53×10^{3}
Acetonitrile	0	0	0	0	0	0	0	0	0	0	0	0	0
Benzene	0	0	0	0	0	0	0	0	0	0	0	0	0
Butanol	0	0	0	0	0	0	0	0	0	0	0	0	0
Polychlorinated biphenyls	1.59×10^{-1}	1.06×10^{-1}	4.25×10^{-1}	3.19×10^{-1}	3.19×10^{-1}	4.25×10^{-1}	3.19×10^{-1}	3.99×10^{-1}	4.25×10^{-1}	4.78×10^{-1}	1.59×10^{-1}	4.25×10^{-1}	3.96
2,4,6-Trichlorophenol	0	0	0	0	0	0	0	0	0	0	0	0	0

Note: To convert kilograms to pounds, multiply by 2.2046.
Key: butanol=n-butyl alcohol.
Source: SAIC 2011.

D.1.7 Inventories and Flowsheets

Retrieval of tank waste, processing and stabilization of the waste streams, and closure of the tank farms would generate a number of waste forms for onsite disposal. Volume and constituent inventory estimates for these waste forms are based on the mass balances that are applicable for the set of process operations proposed for each alternative (CEES 2007, 2010; DOE 2003a, 2003b), as well as on additional assumptions related to the generation and recovery efficiencies of the volatile constituents tritium, carbon dioxide, nitrate, mercury, and iodine during thermal processing.

Assumptions applied to these constituents for thermal processes under all alternatives include the following:

- Iodine-129: 80 percent goes to offgas (CEES 2010; Whyatt, Shade, and Stegen 1996)
- Carbon-14: 100 percent to offgas (Zamecnik and Crawford 2003)
- Tritium: 100 percent to offgas (BNI 2002)
- Mercury: 100 percent to offgas (CEES 2010)
- Nitrate: 100 percent to offgas (BNI 2002)
- All hazardous chemicals (organics): 100 percent to offgas

The 11 Tank Closure alternatives developed for this *TC & WM EIS* are differentiated based on waste retrieval, waste treatment, and waste-form characteristics, as described in Table D–34. The retrieval efficiencies considered vary from 90 to 99.9 percent of waste volume. Treatment options considered include the following:

- Retrieval and treatment of transuranic (TRU) waste constituents from selected tanks
- Solid-liquid separations designed to direct long-lived radionuclides to the immobilized high-level radioactive waste (IHLW) stream
- Ion exchange removal of technetium-99 to remove a mobile constituent from the low-activity waste (LAW) stream
- Recovery of iodine-129 from melter offgas to control releases to the atmosphere
- Distribution of recovered activity among waste forms, including IHLW glass and LAW forms, immobilized low-activity waste (ILAW) glass, bulk vitrification glass, cast stone waste, steam reforming waste, sulfate grout, and secondary (iodine) grout
- Treatment of the cesium-137 and strontium-90 capsules

Table D–34. Tank Closure Alternatives – Summary of Conditions

Tank Closure Alternative	Retrieval Efficiency (percent)	Supplemental Treatment 200-East Area			Primary LAW Form		TRU Waste Treatment
		Cesium Removal	Technetium-99 Removal	Sulfate Removal	200-East Area	200-West Area	
1	0	(a)	(a)	(a)	(a)	(a)	(a)
2A	99	Yes	No	No	ILAW glass	(b)	No
2B	99	Yes	Yes	No	ILAW glass	(b)	No
3A	99	Yes	No	No	ILAW glass; BV glass	BV glass	Yes
3B	99	Yes	Yes	No	ILAW glass; cast stone waste	Cast stone waste	Yes
3C	99	Yes	No	No	ILAW glass; steam reforming waste	Steam reforming waste	Yes
4	99.9	Yes	No	No	ILAW glass; cast stone waste	BV glass	Yes
5	90	Yes	No	Yes	ILAW glass; cast stone waste	BV glass	Yes
6A	99.9	Yes	No	No	Not applicable	(c)	No
6B	99.9	Yes	No	No	ILAW glass[d]	(c)	No
6C	99	Yes	No	No	ILAW glass[d]	(c)	No

[a] Not applicable; no retrieval or processing under Alternative 1.
[b] Not applicable; no treatment in the 200-West Area under Alternative 2A or 2B.
[c] Not applicable; no treatment in the 200-West Area under Alternative 6A, 6B, or 6C.
[d] ILAW glass would be managed and disposed of as immobilized high-level radioactive waste glass under Alternatives 6B and 6C.
Key: BV=bulk vitrification; ILAW=immobilized low-activity waste; LAW=low-activity waste; TRU=transuranic.

An additional differentiating characteristic is location of the waste processing facilities. Under Tank Closure Alternative 1: No Action, retrieval and processing would not occur, and the waste would be managed in place as required for safety and protection of the environment. This arrangement is represented in Figure D–1. Material balances under Tank Closure Alternative 1 are presented in Tables D–35 and D–36. The BBI estimate, summarized in Tables D–4 through D–7, constitutes the inventories under this alternative.

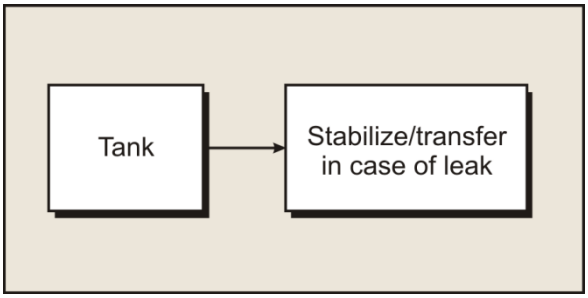


Figure D–1. Tank Closure Alternative 1 Flowsheet

Under Tank Closure Alternatives 2A, 2B, 6A, 6B, and 6C, all processing would occur in the 200-East Area. Under the remaining Tank Closure alternatives, processing would occur in both the 200-East and 200-West Areas. Under all alternatives other than Tank Closure Alternative 1, the initial processing step in both the 200-East and 200-West Areas would be solid-liquid separations, with recovered solids vitrified as IHLW glass. Subsequent processing steps and related mass balances under each Tank Closure alternative are described in the following paragraphs.

Table D–35. Tank Closure Alternative 1 Radioactive Constituents of Potential Concern Balance

	Iodine-129		Cesium-137		Carbon-14		Hydrogen-3 (Tritium)		Uranium-233, -234, -235, -238		Neptunium-237		Plutonium -239, -240		Strontium-90		Technetium-99	
	Curies	% of BBI	Curies	% of BBI	Curies	% of BBI	Curies	% of BBI	Curies	% of BBI	Curies	% of BBI	Curies	% of BBI	Curies	% of BBI	Curies	% of BBI
Best-Basis Inventory																		
BBI[a]	4.82×10^{1}	N/A	4.58×10^{7}	N/A	3.12×10^{3}	N/A	1.21×10^{4}	N/A	9.38×10^{2}	N/A	1.41×10^{2}	N/A	8.14×10^{4}	N/A	5.05×10^{7}	N/A	2.97×10^{4}	N/A
Tank Closure Waste Inventory																		
Tank residual waste	4.82×10^{1}	100.0	4.58×10^{7}	100.0	3.12×10^{3}	100.0	1.21×10^{4}	100.0	9.38×10^{2}	100.0	1.41×10^{2}	100.0	8.14×10^{4}	100.0	5.05×10^{7}	100.0	2.97×10^{4}	100.0
Total	**4.82×10^{1}**	**100.0**	**4.58×10^{7}**	**100.0**	**3.12×10^{3}**	**100.0**	**1.21×10^{4}**	**100.0**	**9.38×10^{2}**	**100.0**	**1.41×10^{2}**	**100.0**	**8.14×10^{4}**	**100.0**	**5.05×10^{7}**	**100.0**	**2.97×10^{4}**	**100.0**
Other Inventory																		
Cesium and strontium capsules[b]	0	N/A	4.63×10^{7}	N/A	0	N/A	0	N/A	0	N/A	0	N/A	0	N/A	2.04×10^{7}	N/A	0	N/A

[a] Source of BBI data is *Inventory and Source Term Data Package*, DOE-ORP-2003-02, Rev. 0 (DOE 2003a). BBI percentages are rounded to the nearest tenth.
[b] Cesium and strontium capsules would remain in storage at the Waste Encapsulation and Storage Facility.
Key: %=percent; BBI=Best-Basis Inventory; N/A=not applicable.
Source: SAIC 2011.

Table D–36. Tank Closure Alternative 1 Chemical Constituents of Potential Concern Balance

	Chromium		Mercury		Nitrate		Lead		Total Uranium		Acetonitrile		Benzene		Butanol		PCBs		2,4,6-TCP	
	Kg	% of BBI	Kg	% of BBI	Kg	% of BBI	Kg	% of BBI	Kg	% of BBI	Kg	% of BBI	Kg	% of BBI	Kg	% of BBI	Kg	% of BBI	Kg	% of BBI
Best-Basis Inventory																				
BBI[a]	5.98×10^{5}	N/A	1.83×10^{3}	N/A	7.08×10^{7}	N/A	8.41×10^{4}	N/A	5.97×10^{5}	N/A	2.95×10^{4}	N/A	2.40	N/A	3.45×10^{6}	N/A	1.68×10^{3}	N/A	1.11	N/A
Tank Closure Waste Inventory																				
Tank residual waste	5.98×10^{5}	100.0	1.83×10^{3}	100.0	7.08×10^{7}	100.0	8.41×10^{4}	100.0	5.97×10^{5}	100.0	2.95×10^{4}	100.0	2.40	100.0	3.45×10^{6}	100.0	1.68×10^{3}	100.0	1.11	100.0
Total	**5.98×10^{5}**	**100.0**	**1.83×10^{3}**	**100.0**	**7.08×10^{7}**	**100.0**	**8.41×10^{4}**	**100.0**	**5.97×10^{5}**	**100.0**	**2.95×10^{4}**	**100.0**	**2.40**	**100.0**	**3.45×10^{6}**	**100.0**	**1.68×10^{3}**	**100.0**	**1.11**	**100.0**

[a] Source of BBI data is *Inventory and Source Term Data Package*, DOE-ORP-2003-02, Rev. 0 (DOE 2003a). BBI percentages are rounded to the nearest tenth.
Note: To convert kilograms to pounds, multiply by 2.2046.
Key: %=percent; BBI=Best-Basis Inventory; butanol=n-butyl alcohol; Kg=kilograms; N/A=not applicable; PCB=polychlorinated biphenyl; TCP=trichlorophenol.
Source: SAIC 2011.

The waste forms of the long-lived, mobile radionuclides, technetium-99 and iodine-129, are of interest in regard to long-term performance assessment. Both elements exist as water-soluble species and move through process operations in the liquid phase. To facilitate evaluation of the relative efficiency of retention of these two radionuclides in the LAW forms, separation of technetium-99 from the 200-East Area liquid stream and immobilization into IHLW glass was considered under Tank Closure Alternatives 2B and 3B. Under Tank Closure Alternative 2B, with technetium-99 removal in the WTP, approximately 98 percent of the BBI estimate for technetium-99 would be solidified in IHLW glass; under Tank Closure Alternative 3B, approximately 66 percent of the BBI estimate for technetium-99 would be solidified in IHLW glass. Under this latter alternative, approximately 32 percent of the BBI estimate for technetium-99 would be contained in the 200-East and 200-West Area cast stone waste. Without technetium-99 removal, under Tank Closure Alternatives 3A and 3C, approximately 28 percent of the BBI estimate for technetium-99 would be solidified in ILAW glass, and approximately 70 percent of the BBI estimate for technetium-99 would be solidified in the bulk vitrification glass or steam reforming waste. The remaining 2 percent would be encapsulated in a (secondary waste) grout.

The WTP Pretreatment Facility was originally designed to remove technetium and blend the technetium removed from the LAW vitrification feed with HLW solids for feed to HLW vitrification. However, based on reviews of technetium-99 in ILAW glass, DOE and Ecology agreed to delete technetium removal from the WTP permit (Hedges 2008). With this modification, technetium-99 would not be separated from the pretreated LAW feed and combined with the HLW solids for vitrification processing into IHLW glass. Thus, the technetium-99 content of the resulting IHLW glass would decrease, while the technetium-99 concentration in the ILAW glass would increase.

Various alternatives in this *TC & WM EIS* examine the impacts of removing the technetium-99 in the WTP. Table D–34 indicates whether technetium-99 removal would occur under the various alternatives. If technetium-99 is not removed in WTP pretreatment, most of it would be immobilized in ILAW glass. If technetium-99 removal occurs during WTP pretreatment, most of the technetium-99 would be immobilized in IHLW glass. See Appendix E, Section E.1.2.3.10, for further details.

The distribution of the radionuclides can vary based on how the waste is treated and on the types of waste produced under each Tank Closure alternative. The partitioning of iodine among the waste forms is affected by whether the processing is thermal or nonthermal. In nonthermal processing, iodine would remain in the cast stone waste. Thermal processing in the WTP HLW and LAW melters or in the bulk vitrification and steam reforming processes would leave a portion of the iodine in the feed stream, where it would be volatilized and recovered from the offgas for disposal in a secondary grout. Thus, for thermal processing, it was assumed that approximately 20 percent of the feed iodine would be solidified in ILAW glass, bulk vitrification glass, and steam reforming waste, and approximately 80 percent would be encapsulated in a (secondary waste) grout (CEES 2010). Distribution of technetium-99 and iodine-129 among the waste forms under each alternative is described in detail in the activity balance tables presented in the following text and in Appendix E, Sections E.1.2.3.6 and E.1.2.3.8.

Tank Closure Alternatives 2A and 2B both involve processing waste in the WTP to form IHLW glass and ILAW glass. No supplemental technology would be utilized to treat the LAW portion of the waste. Tank Closure Alternative 2A does not include technetium-99 removal; therefore, the bulk of the technetium-99 would be immobilized in the ILAW glass. Tank Closure Alternative 2B includes technetium-99 removal from the LAW stream, so the majority of the technetium-99 inventory, approximately 97.7 percent of the BBI estimate for technetium-99, would be immobilized in IHLW glass. Under both Tank Closure Alternatives 2A and 2B, it was estimated that approximately 20 percent of the retrieved iodine would be solidified in ILAW glass, while the remaining 80 percent would be encapsulated in grout (secondary waste). Appendix N, Section N.3.8, provides a sensitivity analysis of additional retention of iodine-129 in ILAW glass. Flowsheet schematics for Tank Closure Alternatives 2A and 2B are presented in

Figures D–2 and D–3, respectively. Material balances under Tank Closure Alternatives 2A and 2B are presented in Tables D–37 through D–40.

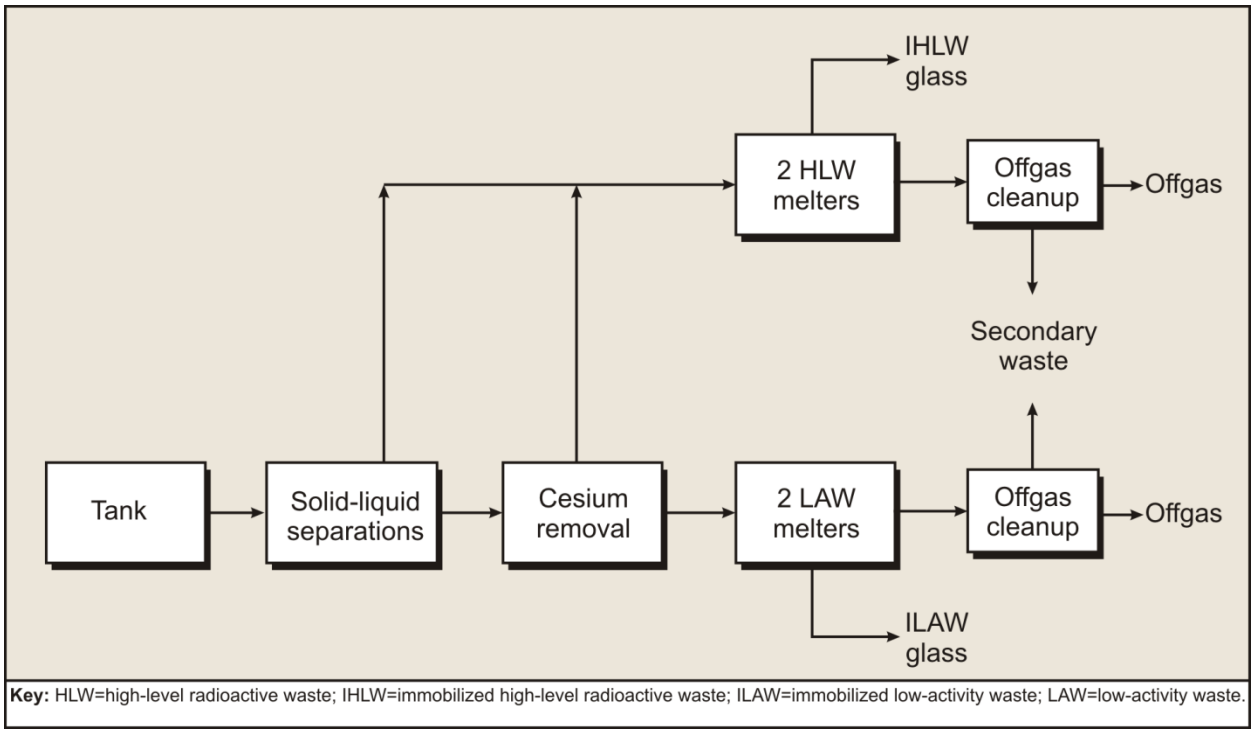


Figure D–2. Tank Closure Alternative 2A Flowsheet

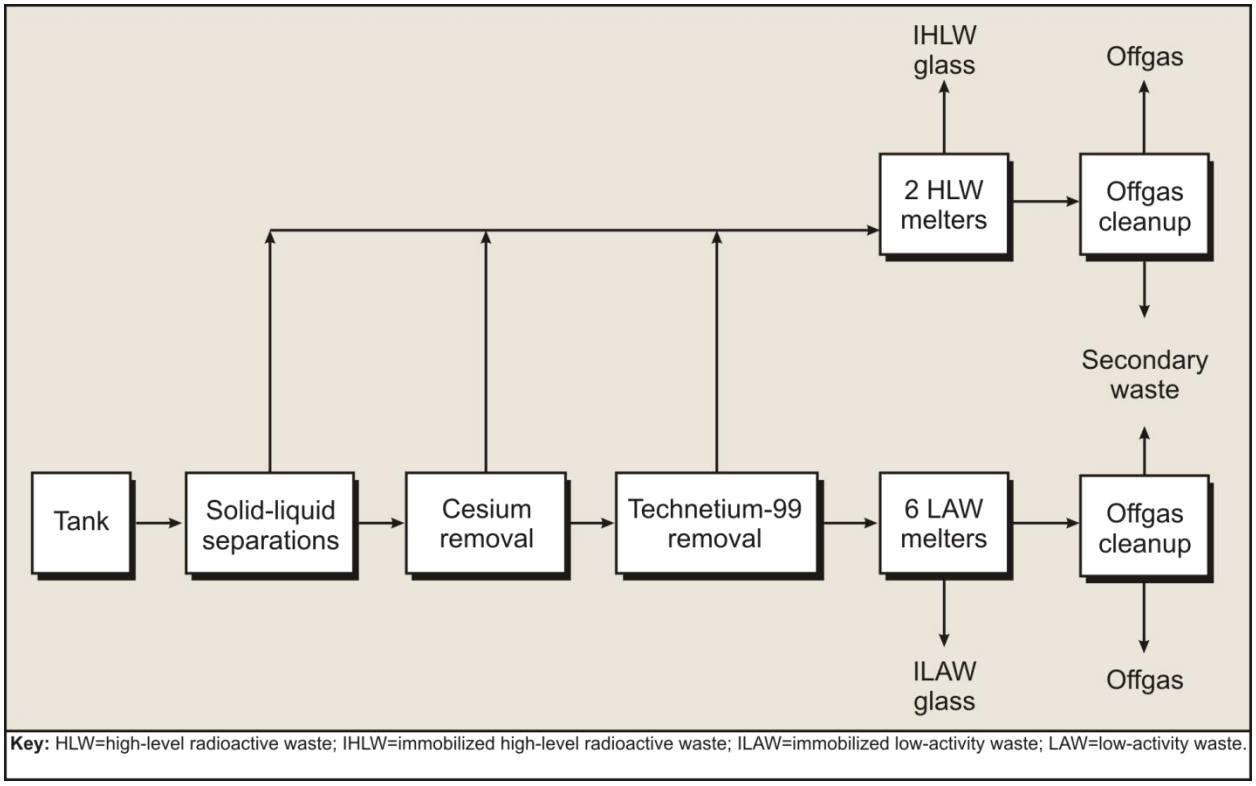


Figure D–3. Tank Closure Alternative 2B Flowsheet

Table D–37. Tank Closure Alternative 2A Radioactive Constituents of Potential Concern Balance

	Iodine-129		Cesium-137		Carbon-14		Hydrogen-3 (Tritium)		Uranium-233, -234, -235, -238		Neptunium-237		Plutonium -239, -240		Strontium-90		Technetium-99	
	Curies	% of BBI	Curies	% of BBI	Curies	% of BBI	Curies	% of BBI	Curies	% of BBI	Curies	% of BBI	Curies	% of BBI	Curies	% of BBI	Curies	% of BBI
Best-Basis Inventory																		
BBI[a]	4.82×10^{1}	N/A	4.58×10^{7}	N/A	3.12×10^{3}	N/A	1.21×10^{4}	N/A	9.38×10^{2}	N/A	1.41×10^{2}	N/A	8.14×10^{4}	N/A	5.05×10^{7}	N/A	2.97×10^{4}	N/A
Tank Closure Waste Inventory																		
Tank residual waste[b]	4.82×10^{-1}	1.0	4.58×10^{5}	1.0	3.12×10^{1}	1.0	1.21×10^{2}	1.0	9.38	1.0	1.41	1.0	8.14×10^{2}	1.0	5.05×10^{5}	1.0	2.97×10^{2}	1.0
IHLW glass[c]	6.99×10^{-3}	0.0	4.49×10^{7}	97.9	0	0.0	0	0.0	8.73×10^{2}	93.1	1.40×10^{2}	99.0	8.06×10^{4}	99.0	4.93×10^{7}	97.6	2.47×10^{2}	0.8
ILAW glass and retired LAW melters	9.56	19.8	4.45×10^{5}	1.0	0	0.0	0	0.0	5.47×10^{1}	5.8	8.35×10^{-3}	0.0	1.45	0.0	2.30×10^{3}	0.0	2.88×10^{4}	96.9
ETF-generated solid secondary waste[d]	3.36×10^{1}	69.7	4.59×10^{-1}	0.0	8.51	0.3	0	0.0	4.03×10^{-2}	0.0	5.11×10^{-2}	0.0	6.90×10^{-4}	0.0	6.42	0.0	8.63×10^{1}	0.3
Solid secondary waste[e]	4.65	9.7	1.95×10^{5}	0.4	0	0.0	0	0.0	3.64	0.4	2.83×10^{-1}	0.2	1.98×10^{2}	0.2	7.76×10^{5}	1.5	4.31×10^{2}	1.5
Total[f]	**4.83×10^{1}**	**100.2**	**4.60×10^{7}**	**100.2**	**3.97×10^{1}**	**1.3**	**1.21×10^{2}**	**1.0**	**9.41×10^{2}**	**100.3**	**1.41×10^{2}**	**100.2**	**8.16×10^{4}**	**100.2**	**5.06×10^{7}**	**100.1**	**2.99×10^{4}**	**100.5**
Other Inventory																		
Solid and liquid secondary waste from cesium and strontium capsules	0	N/A	1.99×10^{5}	N/A	0	N/A	0	N/A	0	N/A	0	N/A	0	N/A	3.16×10^{5}	N/A	0	N/A
Cesium and strontium capsules[g]	0	N/A	4.59×10^{7}	N/A	0	N/A	0	N/A	0	N/A	0	N/A	0	N/A	1.98×10^{7}	N/A	0	N/A
Air Emissions																		
Treatment air emissions[h]	4.78×10^{1}	N/A	4.69×10^{4}	N/A	3.10×10^{3}	N/A	1.20×10^{4}	N/A	4.65×10^{-1}	N/A	NR	N/A	4.04×10^{1}	N/A	3.55×10^{4}	N/A	1.47×10^{1}	N/A

[a] Source of BBI data is *Inventory and Source Term Data Package*, DOE-ORP-2003-02, Rev. 0 (DOE 2003a).

[b] Represents 99.0 percent retrieval. For analysis purposes, waste inventories from tank waste retrieval leaks and ancillary equipment were assumed to be treated in the Waste Treatment Plant.

[c] To be stored on site until disposition decisions are made and implemented. This inventory would include the retired HLW melters.

[d] Includes secondary liquids that would be sent to the ETF and treated; solids would be disposed of in an Integrated Disposal Facility. Excludes liquid secondary waste from the processing of cesium and strontium capsules, which would be reported separately.

[e] Includes solid low-level radioactive waste and mixed low-level radioactive waste streams that would be generated by the waste treatment operations. Such waste streams would include debris waste, melter consumables, failed process components, analytical laboratory waste, spent resins, spent carbon adsorbent, high-efficiency particulate air filters, and other process-related waste.

[f] Totals may exceed 100 percent due to conservative estimates or rounded numbers. BBI percentages were rounded to the nearest tenth. Carbon-14 and hydrogen-3 (tritium) may not total 100 percent; a portion of each would be released to the offgas streams and stack, and a portion (ETF-generated liquid) would be disposed of in the State-Approved Land Disposal Site.

[g] To be treated in the Waste Treatment Plant, resulting in glass waste, which would be stored on site until disposition decisions are made and implemented.

[h] Includes air emissions from all waste treatment processes, including those from treatment of the cesium and strontium capsules. For analysis purposes, both iodine-129 capture and air emission releases were assumed.

Key: %=percent; BBI=Best-Basis Inventory; ETF=Effluent Treatment Facility; HLW=high-level radioactive waste; IHLW=immobilized high-level radioactive waste; ILAW=immobilized low-activity waste; LAW=low-activity waste; N/A=not applicable; NR=not reported.

Source: SAIC 2011.

Table D–38. Tank Closure Alternative 2A Chemical Constituents of Potential Concern Balance

	Chromium		Mercury		Nitrate		Lead		Total Uranium		Acetonitrile		Benzene		Butanol		PCBs		2,4,6-TCP	
	Kg	% of BBI	Kg	% of BBI	Kg	% of BBI	Kg	% of BBI	Kg	% of BBI	Kg	% of BBI	Kg	% of BBI	Kg	% of BBI	Kg	% of BBI	Kg	% of BBI
Best-Basis Inventory																				
BBI[a]	5.98×10^{5}	N/A	1.83×10^{3}	N/A	7.08×10^{7}	N/A	8.41×10^{4}	N/A	5.97×10^{5}	N/A	2.95×10^{4}	N/A	2.40	N/A	3.45×10^{6}	N/A	1.68×10^{3}	N/A	1.11	N/A
Tank Closure Waste Inventory																				
Tank residual waste[b]	5.98×10^{3}	1.0	1.83×10^{1}	1.0	7.08×10^{5}	1.0	8.41×10^{2}	1.0	5.97×10^{3}	1.0	2.95×10^{2}	1.0	2.40×10^{-2}	1.0	3.45×10^{4}	1.0	1.68×10^{1}	1.0	1.11×10^{-2}	1.0
IHLW glass[c]	1.36×10^{5}	22.7	0	0.0	0	0.0	7.45×10^{4}	88.6	5.52×10^{5}	92.5	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
ILAW glass and retired LAW melters	4.56×10^{5}	76.2	0	0.0	0	0.0	8.88×10^{3}	10.6	3.74×10^{4}	6.3	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
ETF-generated solid secondary waste[d]	4.43×10^{1}	0.0	5.55	0.3	9.01×10^{6}	12.7	4.58	0.0	4.00×10^{1}	0.0	NR	N/A	NR	N/A	NR	N/A	NR	N/A	NR	N/A
Solid secondary waste[e]	1.94×10^{3}	0.3	1.76×10^{3}	96.4	0	0.0	2.47×10^{2}	0.3	2.32×10^{3}	0.4	NR	N/A	NR	N/A	NR	N/A	NR	N/A	NR	N/A
Total[f]	**6.00×10^{5}**	**100.3**	**1.78×10^{3}**	**97.7**	**9.72×10^{6}**	**13.7**	**8.45×10^{4}**	**100.5**	**5.98×10^{5}**	**100.2**	**2.95×10^{2}**	**1.0**	**2.40×10^{-2}**	**1.0**	**3.45×10^{4}**	**1.0**	**1.68×10^{1}**	**1.0**	**1.11×10^{-2}**	**1.0**
Other Inventory[g]																				
Treatment air emissions[h]	NR	N/A	1.81×10^{3}	N/A	NR	N/A	NR	N/A	NR	N/A	NR	N/A	7.40×10^{2}	N/A	NR	N/A	NR	N/A	NR	N/A

a Source of BBI data is *Inventory and Source Term Data Package*, DOE-ORP-2003-02, Rev. 0 (DOE 2003a).

b Represents 99.0 percent retrieval. For analysis purposes, waste inventories from tank waste retrieval leaks and ancillary equipment were assumed to be treated in the Waste Treatment Plant.

c Includes retired HLW melter inventory. IHLW glass would be stored on site until disposition decisions are made and implemented.

d Includes secondary liquids that would be sent to the ETF and treated; solids would be disposed of in an Integrated Disposal Facility.

e Includes solid low-level radioactive waste and mixed low-level radioactive waste streams that would be generated by the waste treatment operations. Such waste streams would include debris waste, melter consumables, failed process components, analytical laboratory waste, spent resins, spent carbon adsorbent, high-efficiency particulate air filters, and other process-related waste. Excludes contaminated liquid effluent waste streams that would be treated at the ETF.

f Totals may exceed 100 percent due to conservative estimates or rounded numbers. BBI percentages were rounded to the nearest tenth. The organic chemicals (acetonitrile, benzene, butanol, PCBs, and 2,4,6-TCP) may not total 100 percent because they would be destroyed during the thermal treatment processes. Nitrate may not total 100 percent because it would be volatilized and released through the facility stack.

g No chemical constituents of potential concern have been reported in the cesium and strontium capsule secondary-waste streams.

h Includes air emissions from all waste treatment processes, including those from treatment of the cesium and strontium capsules. For analysis purposes, both mercury capture and air emission releases were assumed.

Note: To convert kilograms to pounds, multiply by 2.2046.

Key: %=percent; BBI=Best-Basis Inventory; butanol=n-butyl alcohol; ETF=Effluent Treatment Facility; HLW=high-level radioactive waste; IHLW=immobilized high-level radioactive waste; ILAW=immobilized low-activity waste; Kg=kilograms; LAW=low-activity waste; N/A=not applicable; NR=not reported; PCB=polychlorinated biphenyl; TCP=trichlorophenol.

Source: SAIC 2011.

Table D–39. Tank Closure Alternative 2B Radioactive Constituents of Potential Concern Balance

	Iodine-129		Cesium-137		Carbon-14		Hydrogen-3 (Tritium)		Uranium-233, -234, -235, -238		Neptunium-237		Plutonium -239, -240		Strontium-90		Technetium-99	
	Curies	% of BBI	Curies	% of BBI	Curies	% of BBI	Curies	% of BBI	Curies	% of BBI	Curies	% of BBI	Curies	% of BBI	Curies	% of BBI	Curies	% of BBI
Best-Basis Inventory																		
BBI[a]	4.82×10^{1}	N/A	4.58×10^{7}	N/A	3.12×10^{3}	N/A	1.21×10^{4}	N/A	9.38×10^{2}	N/A	1.41×10^{2}	N/A	8.14×10^{4}	N/A	5.05×10^{7}	N/A	2.97×10^{4}	N/A
Tank Closure Waste Inventory																		
Tank residual waste[b]	4.82×10^{-1}	1.0	4.58×10^{5}	1.0	3.12×10^{1}	1.0	1.21×10^{2}	1.0	9.38	1.0	1.41	1.0	8.14×10^{2}	1.0	5.05×10^{5}	1.0	2.97×10^{2}	1.0
IHLW glass[c]	6.99×10^{-3}	0.0	4.49×10^{7}	97.9	0	0.0	0	0.0	8.73×10^{2}	93.1	1.40×10^{2}	99.0	8.06×10^{4}	99.0	4.93×10^{7}	97.6	2.90×10^{4}	97.7
ILAW glass and retired LAW melters	9.56	19.8	4.45×10^{5}	1.0	0	0.0	0	0.0	5.47×10^{1}	5.8	8.35×10^{-3}	0.0	1.45	0.0	2.30×10^{3}	0.0	2.88×10^{2}	1.0
ETF-generated solid secondary waste[d]	3.36×10^{1}	69.7	4.59×10^{-1}	0.0	8.51	0.3	0	0.0	4.03×10^{-2}	0.0	5.11×10^{-2}	0.0	6.90×10^{-4}	0.0	6.42	0.0	8.63×10^{1}	0.3
Solid secondary waste[e]	4.65	9.7	1.95×10^{5}	0.4	0	0.0	0	0.0	3.64	0.4	2.83×10^{-1}	0.2	1.98×10^{2}	0.2	7.76×10^{5}	1.5	4.92×10^{2}	1.7
Total[f]	**4.83×10^{1}**	**100.2**	**4.60×10^{7}**	**100.2**	**3.97×10^{1}**	**1.3**	**1.21×10^{2}**	**1.0**	**9.41×10^{2}**	**100.3**	**1.41×10^{2}**	**100.2**	**8.16×10^{4}**	**100.2**	**5.06×10^{7}**	**100.1**	**3.02×10^{4}**	**101.7**
Other Inventory																		
Solid and liquid secondary waste from cesium and strontium capsules	0	N/A	1.99×10^{5}	N/A	0	N/A	0	N/A	0	N/A	0	N/A	0	N/A	3.16×10^{5}	N/A	0	N/A
Cesium and strontium capsules[g]	0	N/A	4.59×10^{7}	N/A	0	N/A	0	N/A	0	N/A	0	N/A	0	N/A	1.98×10^{7}	N/A	0	N/A
Rubble, soil, and equipment[h]	1.67×10^{-2}	N/A	1.31×10^{4}	N/A	1.47	N/A	6.03	N/A	4.82×10^{-1}	N/A	3.24×10^{-2}	N/A	4.32×10^{1}	N/A	3.05×10^{4}	N/A	9.72	N/A
Air Emissions																		
Treatment air emissions[i]	4.78×10^{1}	N/A	4.69×10^{4}	N/A	3.10×10^{3}	N/A	1.20×10^{4}	N/A	4.65×10^{-1}	N/A	NR	N/A	4.04×10^{1}	N/A	3.55×10^{4}	N/A	1.47×10^{1}	N/A

a Source of BBI data is *Inventory and Source Term Data Package*, DOE-ORP-2003-02, Rev. 0 (DOE 2003a).

b Represents 99.0 percent retrieval. For analysis purposes, waste inventories from tank waste retrieval leaks and ancillary equipment were assumed to be treated in the Waste Treatment Plant.

c To be stored on site until disposition decisions are made and implemented. This inventory would include the retired HLW melters.

d Includes secondary liquids that would be sent to the ETF and treated; solids would be disposed of in an Integrated Disposal Facility. Excludes liquid secondary waste from the processing of cesium and strontium capsules, which would be reported separately.

e Includes solid low-level radioactive waste and mixed low-level radioactive waste streams that would be generated by the waste treatment operations. Such waste streams would include debris waste, melter consumables, failed process components, analytical laboratory waste, spent resins, spent carbon adsorbent, high-efficiency particulate air filters, and other process-related waste. The value for technetium-99 includes 6.04×10^{1} curies of technetium-99 that would remain in the spent resin from the technetium-99 removal process.

f Totals may exceed 100 percent due to conservative estimates or rounded numbers. BBI percentages were rounded to the nearest tenth. Carbon-14 and hydrogen-3 (tritium) may not total 100 percent; a portion of each would be released to the offgas streams and stack, and a portion (ETF-generated liquid) would be disposed of in the State-Approved Land Disposal Site.

g To be treated in the Waste Treatment Plant, resulting in glass waste, which would be stored on site until disposition decisions are made and implemented.

h Rubble, soil, and equipment would be generated by removal of 4.6 meters (15 feet) of soil and ancillary equipment at the BX and SX tank farms. This material would be disposed of in the River Protection Project Disposal Facility.

i Includes air emissions from all waste treatment processes, including those from treatment of the cesium and strontium capsules. For analysis purposes, both iodine-129 capture and air emission releases were assumed.

Key: %=percent; BBI=Best-Basis Inventory; ETF=Effluent Treatment Facility; HLW=high-level radioactive waste; IHLW=immobilized high-level radioactive waste; ILAW=immobilized low-activity waste; LAW=low-activity waste; N/A=not applicable; NR=not reported.

Source: SAIC 2011.

Table D–40. Alternative 2B Chemical Constituents of Potential Concern Balance

	Chromium		Mercury		Nitrate		Lead		Total Uranium		Acetonitrile		Benzene		Butanol		PCBs		2,4,6-TCP	
	Kg	% of BBI	Kg	% of BBI	Kg	% of BBI	Kg	% of BBI	Kg	% of BBI	Kg	% of BBI	Kg	% of BBI	Kg	% of BBI	Kg	% of BBI	Kg	% of BBI
Best-Basis Inventory																				
BBI[a]	5.98×10^{5}	N/A	1.83×10^{3}	N/A	7.08×10^{7}	N/A	8.41×10^{4}	N/A	5.97×10^{5}	N/A	2.95×10^{4}	N/A	2.40	N/A	3.45×10^{6}	N/A	1.68×10^{3}	N/A	1.11	N/A
Tank Closure Waste Inventory																				
Tank residual waste[b]	5.98×10^{3}	1.0	1.83×10^{1}	1.0	7.08×10^{5}	1.0	8.41×10^{2}	1.0	5.97×10^{3}	1.0	2.95×10^{2}	1.0	2.40×10^{-2}	1.0	3.45×10^{4}	1.0	1.68×10^{1}	1.0	1.11×10^{-2}	1.0
IHLW glass[c]	1.36×10^{5}	22.7	0	0.0	0	0.0	7.45×10^{4}	88.6	5.52×10^{5}	92.5	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
ILAW glass and retired LAW melters	4.56×10^{5}	76.2	0	0.0	0	0.0	8.88×10^{3}	10.6	3.74×10^{4}	6.3	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
ETF-generated solid secondary waste[d]	4.43×10^{1}	0.0	5.55	0.3	9.01×10^{6}	12.7	4.58	0.0	4.00×10^{1}	0.0	NR	N/A	NR	N/A	NR	N/A	NR	N/A	NR	N/A
Solid secondary waste[e]	1.94×10^{3}	0.3	1.76×10^{3}	96.4	0	0.0	2.47×10^{2}	0.3	2.32×10^{3}	0.4	NR	N/A	NR	N/A	NR	N/A	NR	N/A	NR	N/A
Total[f]	**6.00×10^{5}**	**100.3**	**1.78×10^{3}**	**97.7**	**9.72×10^{6}**	**13.7**	**8.45×10^{4}**	**100.5**	**5.98×10^{5}**	**100.2**	**2.95×10^{2}**	**1.0**	**2.40×10^{-2}**	**1.0**	**3.45×10^{4}**	**1.0**	**1.68×10^{1}**	**1.0**	**1.11×10^{-2}**	**1.0**
Other Inventory[g]																				
Rubble, soil, and equipment[h]	5.86×10^{2}	N/A	2.22	N/A	3.93×10^{4}	N/A	3.34×10^{1}	N/A	6.60×10^{2}	N/A	NR	N/A	NR	N/A	NR	N/A	NR	N/A	NR	N/A
Air Emissions																				
Treatment air emissions[i]	NR	N/A	1.81×10^{3}	N/A	NR	N/A	NR	N/A	NR	N/A	NR	N/A	6.14×10^{2}	N/A	NR	N/A	NR	N/A	NR	N/A

a Source of BBI data is *Inventory and Source Term Data Package*, DOE-ORP-2003-02, Rev. 0 (DOE 2003a).

b Represents 99.0 percent retrieval. For analysis purposes, waste inventories from tank waste retrieval leaks and ancillary equipment were assumed to be treated in the Waste Treatment Plant.

c Includes retired HLW melter inventory. IHLW glass would be stored on site until disposition decisions are made and implemented.

d Includes secondary liquids that would be sent to the ETF and treated; solids would be disposed of in an Integrated Disposal Facility.

e Includes solid low-level radioactive waste and mixed low-level radioactive waste streams that would be generated by the waste treatment operations. These waste streams would include debris waste, melter consumables, failed process components, analytical laboratory waste, spent resins, spent carbon adsorbent, high-efficiency particulate air filters, and other process-related waste. Excludes contaminated liquid effluent waste streams that would be treated at the ETF.

f Totals may exceed 100 percent due to conservative estimates or rounded numbers. BBI percentages were rounded to the nearest tenth. The organic chemicals (acetonitrile, benzene, butanol, PCBs, and 2,4,6-TCP) may not total 100 percent because they would be destroyed during the thermal treatment processes. Nitrate may not total 100 percent because it would be volatilized and released through the facility stack.

g No chemical constituents of potential concern have been reported in the cesium and strontium capsule secondary-waste streams.

h Rubble, soil, and equipment would be generated by removal of 4.6 meters (15 feet) of soil and ancillary equipment at the BX and SX tank farms. This material would be disposed of in the River Protection Project Disposal Facility.

i Includes air emissions from all waste treatment processes, including those from treatment of the cesium and strontium capsules. For analysis purposes, both mercury capture and air emission releases were assumed.

Note: To convert kilograms to pounds, multiply by 2.2046.
Key: %=percent; BBI=Best-Basis Inventory; butanol=n-butyl alcohol; ETF=Effluent Treatment Facility; HLW=high-level radioactive waste; IHLW=immobilized high-level radioactive waste; ILAW=immobilized low-activity waste; Kg=kilograms; LAW=low-activity waste; N/A=not applicable; NR=not reported; PCB=polychlorinated biphenyl; TCP=trichlorophenol.
Source: SAIC 2011.

Tank Closure Alternatives 3A, 3B, and 3C involve processing waste to produce IHLW glass and ILAW glass, but they differ in that Alternative 3A would produce a supplemental bulk vitrification glass, Alternative 3B would produce a supplemental cast stone waste form, and Alternative 3C would produce a supplemental steam reforming waste form from a portion of the LAW stream. Technetium-99 would be immobilized in the ILAW and the bulk vitrification glass or steam reforming waste under Tank Closure Alternatives 3A and 3C, respectively; approximately 66 percent of the estimated BBI for technetium-99 would be immobilized in the IHLW under Alternative 3B using a technetium-99 removal process in the WTP. Under Tank Closure Alternatives 3A, 3B, and 3C, the ILAW glass would contain 5.8 percent of the estimated BBI for iodine-129, and the bulk vitrification glass, cast stone waste, and steam reforming waste would contain 14.0 percent, 70.1 percent, and 14.0 percent, respectively, of the estimated BBI for iodine-129. Flowsheet schematics for Tank Closure Alternatives 3A, 3B, and 3C are presented as Figures D–4, D–5, and D–6, respectively. Material balances under Alternatives 3A, 3B, and 3C are presented in Tables D–41 through D–46.

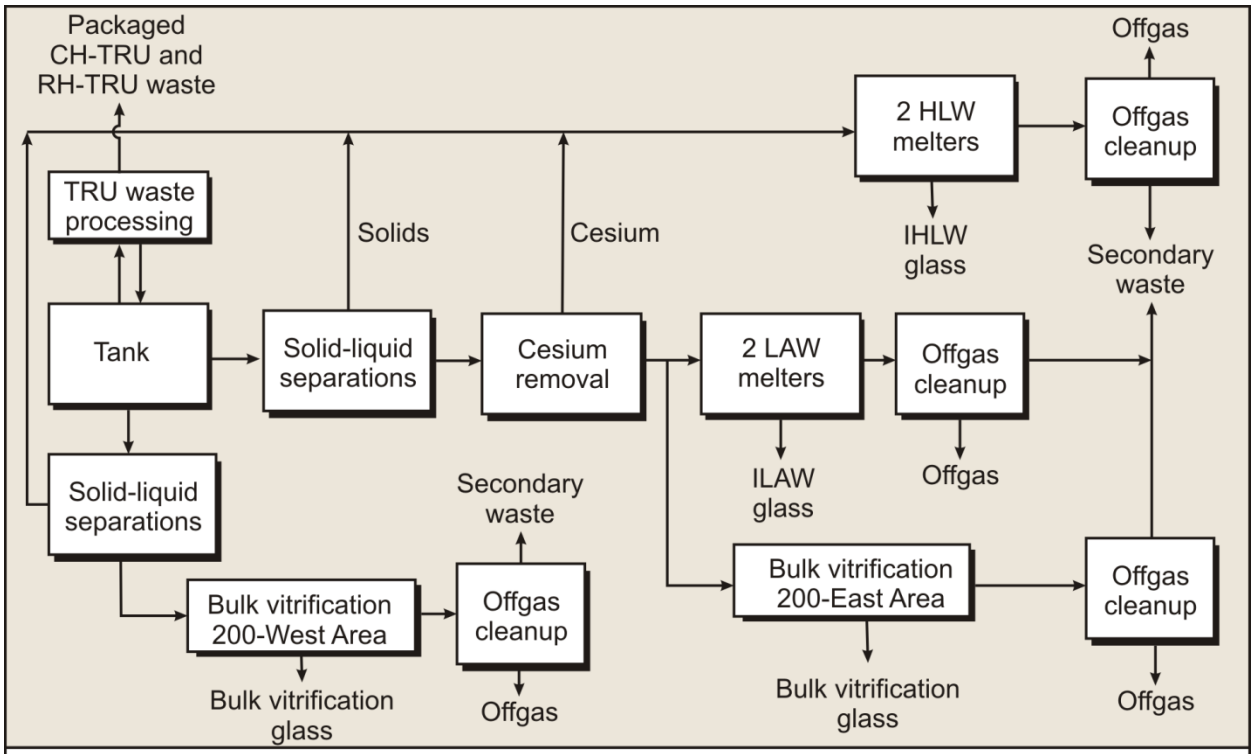


Figure D–4. Tank Closure Alternative 3A Flowsheet

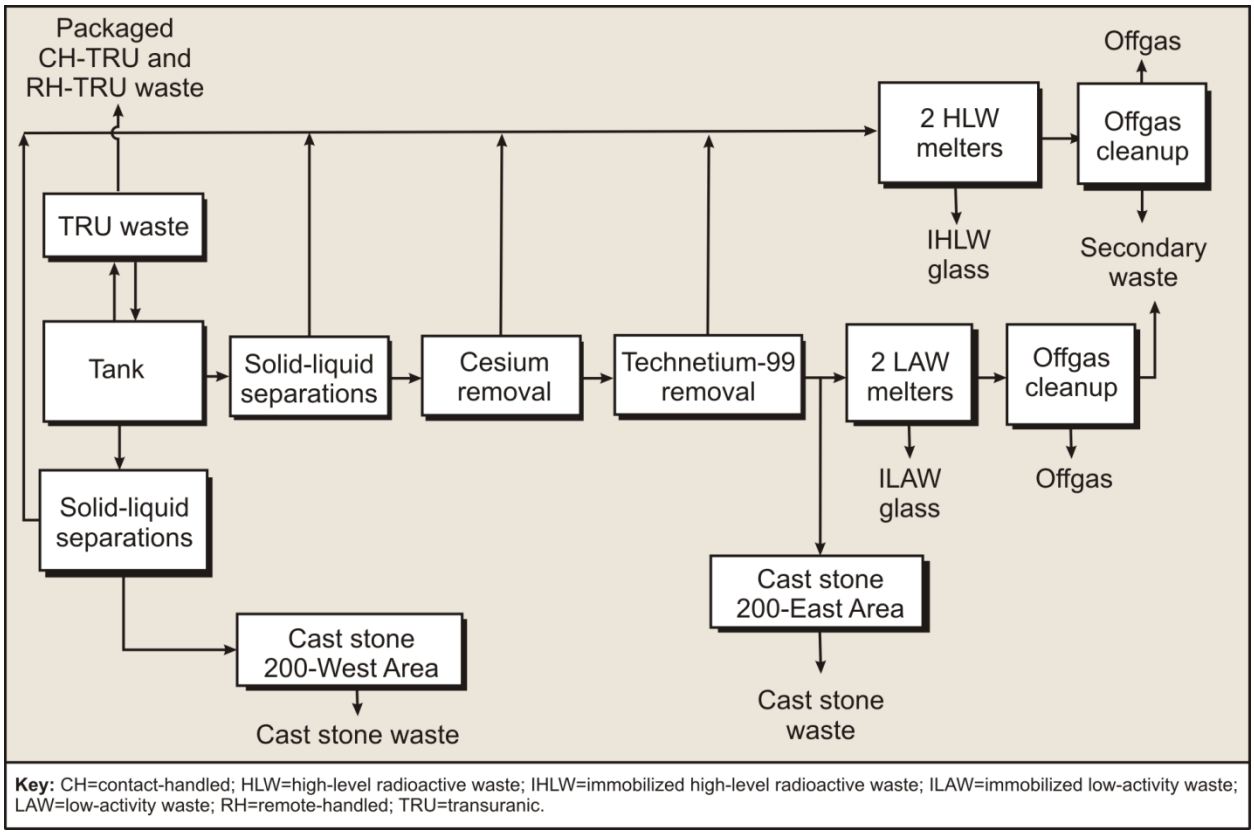


Figure D–5. Tank Closure Alternative 3B Flowsheet

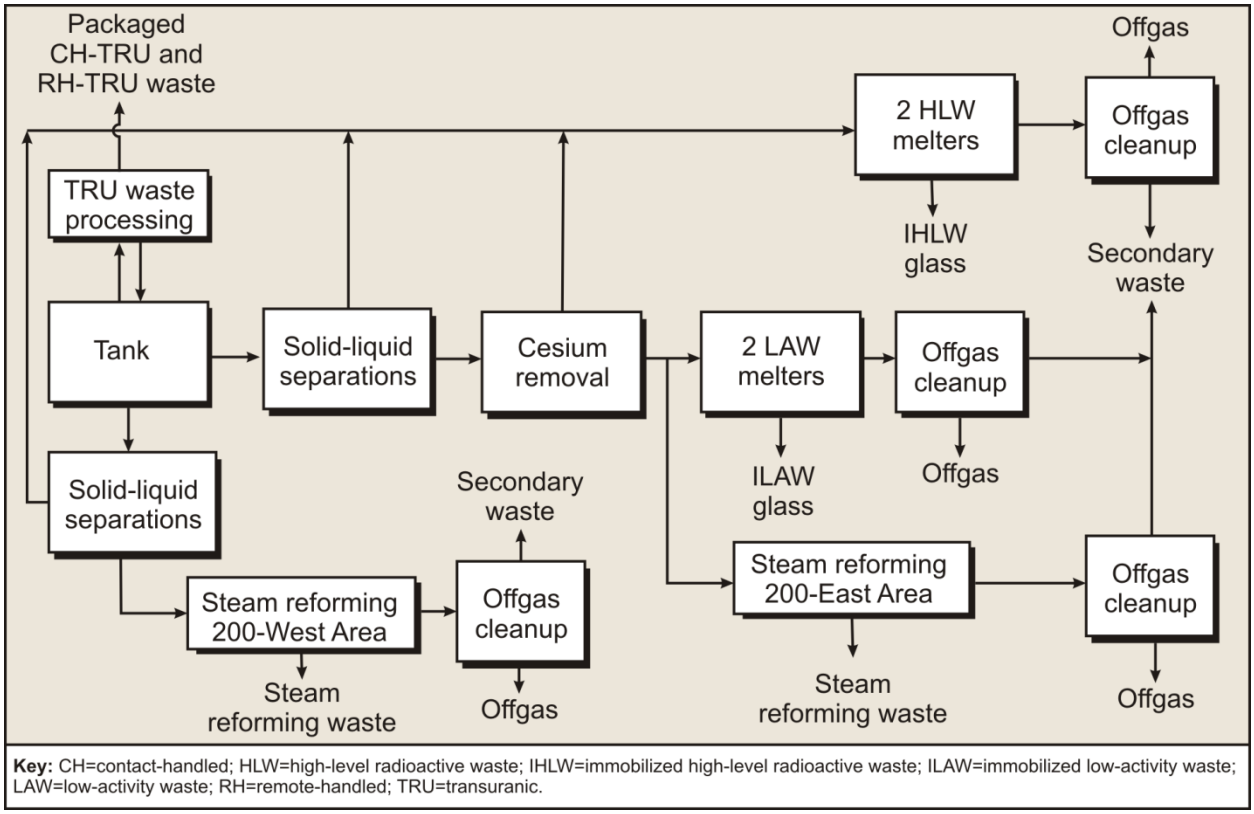


Figure D–6. Tank Closure Alternative 3C Flowsheet

Table D–41. Tank Closure Alternative 3A Radioactive Constituents of Potential Concern Balance

	Iodine-129		Cesium-137		Carbon-14		Hydrogen-3 (Tritium)		Uranium-233, -234, -235, -238		Neptunium-237		Plutonium -239, -240		Strontium-90		Technetium-99	
	Curies	% of BBI	Curies	% of BBI	Curies	% of BBI	Curies	% of BBI	Curies	% of BBI	Curies	% of BBI	Curies	% of BBI	Curies	% of BBI	Curies	% of BBI
Best-Basis Inventory																		
BBI[a]	4.82×10^{1}	N/A	4.58×10^{7}	N/A	3.12×10^{3}	N/A	1.21×10^{4}	N/A	9.38×10^{2}	N/A	1.41×10^{2}	N/A	8.14×10^{4}	N/A	5.05×10^{7}	N/A	2.97×10^{4}	N/A
Tank Closure Waste Inventory																		
Tank residual waste[b]	4.82×10^{-1}	1.0	4.58×10^{5}	1.0	3.12×10^{1}	1.0	1.21×10^{2}	1.0	9.38	1.0	1.41	1.0	8.14×10^{2}	1.0	5.05×10^{5}	1.0	2.97×10^{2}	1.0
IHLW glass[c]	1.32×10^{-5}	0.0	4.04×10^{7}	88.1	0	0.0	0	0.0	8.32×10^{2}	88.6	1.38×10^{2}	97.8	7.31×10^{4}	89.8	4.87×10^{7}	96.4	1.49×10^{2}	0.5
ILAW glass and retired LAW melters	2.80	5.8	1.73×10^{5}	0.4	0	0.0	0	0.0	1.63×10^{1}	1.7	2.48×10^{-3}	0.0	4.33×10^{-1}	0.0	6.91×10^{2}	0.0	8.44×10^{3}	28.4
ETF-generated solid secondary waste[d]	3.69×10^{1}	76.5	1.43×10^{1}	0.0	4.74	0.2	0	0.0	8.72×10^{-2}	0.0	5.15×10^{-2}	0.0	9.36×10^{-4}	0.0	5.45×10^{1}	0.0	4.63×10^{1}	0.2
Solid secondary waste[e]	1.36	2.8	1.75×10^{5}	0.4	0	0.0	0	0.0	3.33	0.4	2.79×10^{-1}	0.2	1.80×10^{2}	0.2	7.67×10^{5}	1.5	1.28×10^{2}	0.4
200-East Area BV glass[f]	3.67	7.6	2.27×10^{5}	0.5	0	0.0	0	0.0	2.13×10^{1}	2.3	3.25×10^{-3}	0.0	5.68×10^{-1}	0.0	9.10×10^{2}	0.0	1.12×10^{4}	37.8
200-West Area BV glass[f]	3.08	6.4	4.39×10^{6}	9.6	0	0.0	0	0.0	3.01×10^{1}	3.2	9.58×10^{-1}	0.7	1.04×10^{3}	1.3	4.61×10^{5}	0.9	9.42×10^{3}	31.7
Transuranic waste[g]	5.02×10^{-2}	0.1	3.41×10^{5}	0.7	3.85	0.1	3.33	0.0	4.67×10^{1}	5.0	9.79×10^{-1}	0.7	7.39×10^{3}	9.1	7.52×10^{5}	1.5	3.36×10^{2}	1.1
Total[h]	**4.83×10^{1}**	**100.3**	**4.62×10^{7}**	**100.7**	**3.98×10^{1}**	**1.3**	**1.24×10^{2}**	**1.0**	**9.59×10^{2}**	**102.2**	**1.42×10^{2}**	**100.4**	**8.26×10^{4}**	**101.4**	**5.12×10^{7}**	**101.3**	**3.00×10^{4}**	**101.1**
Other Inventory																		
Solid and liquid secondary waste from cesium and strontium capsules	0	N/A	1.99×10^{5}	N/A	0	N/A	0	N/A	0	N/A	0	N/A	0	N/A	3.16×10^{5}	N/A	0	N/A
Cesium and strontium capsules[i]	0	N/A	4.59×10^{7}	N/A	0	N/A	0	N/A	0	N/A	0	N/A	0	N/A	1.98×10^{7}	N/A	0	N/A
Rubble, soil, and equipment[j]	1.67×10^{-2}	N/A	1.31×10^{4}	N/A	1.47	N/A	6.03	N/A	4.82×10^{-1}	N/A	3.24×10^{-2}	N/A	4.32×10^{1}	N/A	3.05×10^{4}	N/A	9.72	N/A
Air Emissions																		
Treatment air emissions[k]	4.78×10^{1}	N/A	4.69×10^{4}	N/A	3.10×10^{3}	N/A	1.20×10^{4}	N/A	4.52×10^{-1}	N/A	NR	N/A	3.73×10^{1}	N/A	3.55×10^{4}	N/A	1.47×10^{1}	N/A

[a] Source of BBI data is *Inventory and Source Term Data Package*, DOE-ORP-2003-02, Rev. 0 (DOE 2003a).
[b] Represents 99.0 percent retrieval. For analysis purposes, waste inventories from tank waste retrieval leaks and ancillary equipment were assumed to be treated in the Waste Treatment Plant and via supplemental treatment processes.
[c] To be stored on site until disposition decisions are made and implemented. This inventory would include the retired HLW melters.
[d] Includes secondary liquids that would be sent to the ETF and treated; solids would be disposed of in an Integrated Disposal Facility. Excludes liquid secondary waste from the processing of cesium and strontium capsules, which would be reported separately.
[e] Includes solid low-level radioactive waste and mixed low-level radioactive waste streams generated by the waste treatment operations. Such waste streams would include debris waste, melter consumables, failed process components, analytical laboratory waste, spent resins, spent carbon adsorbent, high-efficiency particulate air filters, and other process-related waste.
[f] Includes technetium-99 inventory that resides in the BV waste container insulating material or waste container.
[g] Tank transuranic waste would be disposed of in the Waste Isolation Pilot Plant.
[h] Totals may exceed 100 percent due to conservative estimates or rounded numbers. BBI percentages were rounded to the nearest tenth. Carbon-14 and hydrogen-3 (tritium) may not total 100 percent; a portion of each would be released to the offgas streams and stack, and a portion (ETF-generated liquid) would be disposed of in the State-Approved Land Disposal Site.
[i] To be treated in the Waste Treatment Plant, resulting in glass waste, which would be stored on site until disposition decisions are made and implemented.
[j] Rubble, soil, and equipment would be generated by removal of 4.6 meters (15 feet) of soil and ancillary equipment at the BX and SX tank farms. This material would be disposed of in the River Protection Project Disposal Facility.
[k] Includes air emissions from all waste treatment processes, including those from treatment of the cesium and strontium capsules. For analysis purposes, both iodine-129 capture and air emission releases were assumed.

Key: %=percent; BBI=Best-Basis Inventory; BV=bulk vitrification; ETF=Effluent Treatment Facility; HLW=high-level radioactive waste; IHLW=immobilized high-level radioactive waste; ILAW=immobilized low-activity waste; LAW=low-activity waste; N/A=not applicable; NR=not reported.
Source: SAIC 2011.

Table D–42. Tank Closure Alternative 3A Chemical Constituents of Potential Concern Balance

	Chromium		Mercury		Nitrate		Lead		Total Uranium		Acetonitrile		Benzene		Butanol		PCBs		2,4,6-TCP	
	Kg	% of BBI	Kg	% of BBI	Kg	% of BBI	Kg	% of BBI	Kg	% of BBI	Kg	% of BBI	Kg	% of BBI	Kg	% of BBI	Kg	% of BBI	Kg	% of BBI
Best-Basis Inventory																				
BBI[a]	5.98×10^{5}	N/A	1.83×10^{3}	N/A	7.08×10^{7}	N/A	8.41×10^{4}	N/A	5.97×10^{5}	N/A	2.95×10^{4}	N/A	2.40	N/A	3.45×10^{6}	N/A	1.68×10^{3}	N/A	1.11	N/A
Tank Closure Waste Inventory																				
Tank residual waste[b]	5.98×10^{3}	1.0	1.83×10^{1}	1.0	7.08×10^{5}	1.0	8.41×10^{2}	1.0	5.97×10^{3}	1.0	2.95×10^{2}	1.0	2.40×10^{-2}	1.0	3.45×10^{4}	1.0	1.68×10^{1}	1.0	1.11×10^{-2}	1.0
IHLW glass[c]	1.12×10^{5}	18.6	0	0.0	0	0.0	7.07×10^{4}	84.1	5.11×10^{5}	85.5	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
ILAW glass and retired LAW melters	1.34×10^{5}	22.4	0	0.0	0	0.0	2.67×10^{3}	3.2	1.13×10^{4}	1.9	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
ETF-generated solid secondary waste[d]	2.76×10^{1}	0.0	5.54	0.3	8.14×10^{6}	11.5	7.56×10^{2}	0.9	7.00×10^{1}	0.0	NR	N/A	NR	N/A	NR	N/A	NR	N/A	NR	N/A
Solid secondary waste[e]	8.03×10^{2}	0.1	1.75×10^{3}	96.0	0	0.0	2.17×10^{2}	0.3	2.05×10^{3}	0.3	NR	N/A	NR	N/A	NR	N/A	NR	N/A	NR	N/A
200-East Area BV glass	1.74×10^{5}	29.2	0	0	0	0.0	3.14×10^{3}	3.7	1.47×10^{4}	2.5	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
200-West Area BV glass	1.48×10^{5}	24.7	0	0	0	0.0	3.56×10^{3}	4.2	1.98×10^{4}	3.3	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Transuranic waste[f]	2.83×10^{4}	4.7	3.46×10^{1}	1.9	1.07×10^{6}	1.5	6.43×10^{3}	7.7	5.92×10^{4}	9.9	5.93×10^{2}	2.0	4.83×10^{-2}	2.0	6.95×10^{4}	2.0	3.51×10^{1}	2.1	2.23×10^{-2}	2.0
Total[g]	**6.03×10^{5}**	**100.7**	**1.81×10^{3}**	**99.2**	**9.92×10^{6}**	**14.0**	**8.83×10^{4}**	**105.0**	**6.24×10^{5}**	**104.5**	**8.88×10^{2}**	**3.0**	**7.24×10^{-2}**	**3.0**	**1.04×10^{5}**	**3.0**	**5.19×10^{1}**	**3.1**	**3.34×10^{-2}**	**3.0**
Other Inventory[h]																				
Rubble, soil, and equipment[i]	5.86×10^{2}	N/A	2.22	N/A	3.93×10^{4}	N/A	3.34×10^{1}	N/A	6.60×10^{2}	N/A	NR	N/A	NR	N/A	NR	N/A	NR	N/A	NR	N/A
Air Emissions																				
Treatment air emissions[j]	NR	N/A	1.80×10^{3}	N/A	NR	N/A	NR	N/A	NR	N/A	NR	N/A	2.99×10^{2}	N/A	NR	N/A	NR	N/A	NR	N/A

a Source of BBI data is *Inventory and Source Term Data Package*, DOE-ORP-2003-02, Rev. 0 (DOE 2003a).
b Represents 99.0 percent retrieval. For analysis purposes, waste inventories from tank waste retrieval leaks and ancillary equipment were assumed to be treated in the Waste Treatment Plant and via supplemental treatment processes.
c To be stored on site until disposition decisions are made and implemented. This inventory would include the retired HLW melters.
d Includes secondary liquids that would be sent to the ETF and treated; solids would be disposed of in an Integrated Disposal Facility.
e Includes solid LLW and MLLW streams that would be generated by the waste treatment operations. Such waste streams would include debris waste, melter consumables, failed process components, analytical laboratory waste, spent resins, spent carbon adsorbent, high-efficiency particulate air filters, and other process-related waste. Excludes contaminated liquid effluent waste streams that would be treated at the ETF.
f Tank transuranic waste would be disposed of in the Waste Isolation Pilot Plant.
g Totals may exceed 100 percent due to conservative estimates or rounded numbers. BBI percentages were rounded to the nearest tenth. The organic chemicals (acetonitrile, benzene, butanol, PCBs, and 2,4,6-TCP) may not total 100 percent because they would be destroyed during the thermal treatment processes. Nitrate may not total 100 percent because it would be volatilized and released through the facility stack.
h No chemical constituents of potential concern have been reported in the cesium and strontium capsule secondary-waste streams.
i Rubble, soil, and equipment would be generated by removal of 4.6 meters (15 feet) of soil and ancillary equipment at the BX and SX tank farms. Disposal would take place in the River Protection Project Disposal Facility.
j Includes air emissions from all waste treatment processes, including those from treatment of the cesium and strontium capsules. For analysis purposes, both mercury capture and air emission releases were assumed.

Note: To convert kilograms to pounds, multiply by 2.2046.
Key: %=percent; BBI=Best-Basis Inventory; butanol=n-butyl alcohol; BV=bulk vitrification; ETF=Effluent Treatment Facility; HLW=high-level radioactive waste; IHLW=immobilized high-level radioactive waste; ILAW=immobilized low-activity waste; Kg=kilograms; LAW=low-activity waste; LLW=low-level radioactive waste; MLLW=mixed low-level radioactive waste; N/A=not applicable; NR=not reported; PCB=polychlorinated biphenyl; TCP=trichlorophenol.
Source: SAIC 2011.

Table D–43. Tank Closure Alternative 3B Radioactive Constituents of Potential Concern Balance

	Iodine-129		Cesium-137		Carbon-14		Hydrogen-3 (Tritium)		Uranium-233, -234, -235, -238		Neptunium-237		Plutonium -239, -240		Strontium-90		Technetium-99	
	Curies	% of BBI	Curies	% of BBI	Curies	% of BBI	Curies	% of BBI	Curies	% of BBI	Curies	% of BBI	Curies	% of BBI	Curies	% of BBI	Curies	% of BBI
Best-Basis Inventory																		
BBI[a]	4.82×10^{1}	N/A	4.58×10^{7}	N/A	3.12×10^{3}	N/A	1.21×10^{4}	N/A	9.38×10^{2}	N/A	1.41×10^{2}	N/A	8.14×10^{4}	N/A	5.05×10^{7}	N/A	2.97×10^{4}	N/A
Tank Closure Waste Inventory																		
Tank residual waste[b]	4.82×10^{-1}	1.0	4.58×10^{5}	1.0	3.12×10^{1}	1.0	1.21×10^{2}	1.0	9.38	1.0	1.41	1.0	8.14×10^{2}	1.0	5.05×10^{5}	1.0	2.97×10^{2}	1.0
IHLW glass[c]	1.32×10^{-5}	0.0	4.04×10^{7}	88.1	0	0.0	0	0.0	8.32×10^{2}	88.6	1.38×10^{2}	97.8	7.31×10^{4}	89.8	4.87×10^{7}	96.4	1.97×10^{4}	66.2
ILAW glass and retired LAW melters	2.80	5.8	1.73×10^{5}	0.4	0	0.0	0	0.0	1.63×10^{1}	1.7	2.48×10^{-3}	0.0	4.33×10^{-1}	0.0	6.91×10^{2}	0.0	8.44×10^{1}	0.3
ETF-generated solid secondary waste[d]	9.85	20.5	4.11×10^{-1}	0.0	2.62	0.1	0	0.0	3.65×10^{-2}	0.0	5.05×10^{-2}	0.0	6.32×10^{-4}	0.0	6.34	0.0	5.82×10^{1}	0.2
Solid secondary waste[e]	1.36	2.8	1.75×10^{5}	0.4	0	0.0	0	0.0	3.33	0.4	2.79×10^{-1}	0.2	1.80×10^{2}	0.2	7.67×10^{5}	1.5	3.33×10^{2}	1.1
200-East Area cast stone waste	1.84×10^{1}	38.1	2.28×10^{5}	0.5	1.17×10^{3}	37.3	4.59×10^{3}	38.1	2.13×10^{1}	2.3	3.25×10^{-3}	0.0	5.68×10^{-1}	0.0	9.10×10^{2}	0.0	1.12×10^{2}	0.4
200-West Area cast stone waste	1.54×10^{1}	32.0	4.41×10^{6}	9.6	9.79×10^{2}	31.4	3.85×10^{3}	32.0	3.01×10^{1}	3.2	9.59×10^{-1}	0.7	1.04×10^{3}	1.3	4.61×10^{5}	0.9	9.43×10^{3}	31.7
Transuranic waste[f]	5.02×10^{-2}	0.1	3.41×10^{5}	0.7	3.85	0.1	3.33	0.0	4.67×10^{1}	5.0	9.79×10^{-1}	0.7	7.39×10^{3}	9.1	7.52×10^{5}	1.5	3.36×10^{2}	1.1
Total[g]	**4.83×10^{1}**	**100.3**	**4.62×10^{7}**	**100.7**	**2.18×10^{3}**	**69.9**	**8.57×10^{3}**	**71.1**	**9.59×10^{2}**	**102.2**	**1.42×10^{2}**	**100.4**	**8.26×10^{4}**	**101.4**	**5.12×10^{7}**	**101.3**	**3.03×10^{4}**	**102.0**
Other Inventory																		
Solid and liquid secondary waste from cesium and strontium capsules	0	N/A	1.99×10^{5}	N/A	0	N/A	0	N/A	0	N/A	0	N/A	0	N/A	3.16×10^{5}	N/A	0	N/A
Cesium and strontium capsules[h]	0	N/A	4.59×10^{7}	N/A	0	N/A	0	N/A	0	N/A	0	N/A	0	N/A	1.98×10^{7}	N/A	0	N/A
Rubble, soil, and equipment[i]	1.67×10^{-2}	N/A	1.31×10^{4}	N/A	1.47	N/A	6.03	N/A	4.82×10^{-1}	N/A	3.24×10^{-2}	N/A	4.32×10^{1}	N/A	3.05×10^{4}	N/A	9.72	N/A
Air Emissions																		
Treatment air emissions[j]	1.40×10^{1}	N/A	4.46×10^{4}	N/A	9.53×10^{2}	N/A	3.50×10^{3}	N/A	4.27×10^{-1}	N/A	NR	N/A	3.67×10^{1}	N/A	3.53×10^{4}	N/A	1.00×10^{1}	N/A

[a] Source of BBI data is *Inventory and Source Term Data Package*, DOE-ORP-2003-02, Rev. 0 (DOE 2003a).

[b] Represents 99.0 percent retrieval. For analysis purposes, waste inventories from tank waste retrieval leaks and ancillary equipment were assumed to be treated in the Waste Treatment Plant and via supplemental treatment processes.

[c] To be stored on site until disposition decisions are made and implemented. This inventory would include the retired HLW melters.

[d] Includes secondary liquids that would be sent to the ETF and treated; solids would be disposed of in an Integrated Disposal Facility. Excludes liquid secondary waste from the processing of cesium and strontium capsules, which would be reported separately.

[e] Includes solid low-level radioactive waste and mixed low-level radioactive waste streams that would be generated by the waste treatment operations. Such waste streams would include debris waste, melter consumables, failed process components, analytical laboratory waste, spent resins, spent carbon adsorbent, high-efficiency particulate air filters, and other process-related waste. Excludes contaminated liquid effluent waste streams that would be treated at the ETF, as reported for ETF-generated solid secondary waste in the table above. The value for technetium-99 includes 4.31×10^{1} curies of technetium-99 that would remain in the spent resin after the technetium-99 removal process.

[f] Tank transuranic waste would be disposed of in the Waste Isolation Pilot Plant.

[g] Totals may exceed 100 percent due to conservative estimates or rounded numbers. BBI percentages were rounded to the nearest tenth. Carbon-14 and hydrogen-3 (tritium) may not total 100 percent; a portion of each would be released to the offgas streams and stack, and a portion (ETF-generated liquid) would be disposed of in the State-Approved Land Disposal Site.

[h] To be treated in the Waste Treatment Plant, resulting in glass waste, which would be stored on site until disposition decisions are made and implemented.

[i] Rubble, soil, and equipment would be generated by removal of 4.6 meters (15 feet) of soil and ancillary equipment at the BX and SX tank farms. Disposal would take place in the River Protection Project Disposal Facility.

[j] Includes air emissions from all waste treatment processes, including those from treatment of the cesium and strontium capsules. For analysis purposes, both iodine-129 capture and air emission releases were assumed.

Key: %=percent; BBI=Best-Basis Inventory; ETF=Effluent Treatment Facility; HLW=high-level radioactive waste; IHLW=immobilized high-level radioactive waste; ILAW=immobilized low-activity waste; LAW=low-activity waste; N/A=not applicable; NR=not reported.

Source: SAIC 2011.

Table D–44. Tank Closure Alternative 3B Chemical Constituents of Potential Concern Balance

	Chromium		Mercury		Nitrate		Lead		Total Uranium		Acetonitrile		Benzene		Butanol		PCBs		2,4,6-TCP	
	Kg	% of BBI	Kg	% of BBI	Kg	% of BBI	Kg	% of BBI	Kg	% of BBI	Kg	% of BBI	Kg	% of BBI	Kg	% of BBI	Kg	% of BBI	Kg	% of BBI
Best-Basis Inventory																				
BBI[a]	5.98×10^{5}	N/A	1.83×10^{3}	N/A	7.08×10^{7}	N/A	8.41×10^{4}	N/A	5.97×10^{5}	N/A	2.95×10^{4}	N/A	2.40	N/A	3.45×10^{6}	N/A	1.68×10^{3}	N/A	1.11	N/A
Tank Closure Waste Inventory																				
Tank residual waste[b]	5.98×10^{3}	1.0	1.83×10^{1}	1.0	7.08×10^{5}	1.0	8.41×10^{2}	1.0	5.97×10^{3}	1.0	2.95×10^{2}	1.0	2.40×10^{-2}	1.0	3.45×10^{4}	1.0	1.68×10^{1}	1.0	1.11×10^{-2}	1.0
IHLW glass[c]	1.12×10^{5}	18.6	0	0.0	0	0.0	7.07×10^{4}	84.1	5.11×10^{5}	85.5	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
ILAW glass and retired LAW melters	1.34×10^{5}	22.4	0	0.0	0	0.0	2.67×10^{3}	3.2	1.13×10^{4}	1.9	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
ETF-generated solid secondary waste[d]	1.84×10^{1}	0.0	4.12	0.2	2.63×10^{6}	3.7	5.82	0.0	3.57×10^{1}	0.0	NR	N/A	NR	N/A	NR	N/A	NR	N/A	NR	N/A
Solid secondary waste[e]	8.03×10^{2}	0.1	1.31×10^{3}	71.5	0	0.0	2.17×10^{2}	0.3	2.05×10^{3}	0.3	NR	N/A	NR	N/A	NR	N/A	NR	N/A	NR	N/A
200-East Area cast stone waste	1.76×10^{5}	29.4	2.41×10^{2}	13.2	2.69×10^{7}	38.0	3.51×10^{3}	4.2	1.48×10^{4}	2.5	1.11×10^{4}	37.6	9.03×10^{-1}	37.6	1.30×10^{6}	37.6	6.33	0.4	4.16×10^{-1}	37.6
200-West Area cast stone waste	1.49×10^{5}	24.9	2.19×10^{2}	12.0	2.26×10^{7}	31.9	3.98×10^{3}	4.7	1.99×10^{4}	3.3	9.15×10^{3}	31.0	7.45×10^{-1}	31.0	1.07×10^{6}	31.0	5.22×10^{2}	31.0	3.44×10^{-1}	31.0
TRU waste[f]	2.83×10^{4}	4.7	3.46×10^{1}	1.9	1.07×10^{6}	1.5	6.43×10^{3}	7.7	5.92×10^{4}	9.9	5.93×10^{2}	2.0	4.83×10^{-2}	2.0	6.95×10^{4}	2.0	3.51×10^{1}	2.1	2.23×10^{-2}	2.0
Total[g]	**6.05×10^{5}**	**101.1**	**1.82×10^{3}**	**99.8**	**5.39×10^{7}**	**76.1**	**8.84×10^{4}**	**105.1**	**6.24×10^{5}**	**104.5**	**2.11×10^{4}**	**71.6**	**1.72**	**71.6**	**2.47×10^{6}**	**71.6**	**5.81×10^{2}**	**34.5**	**7.93×10^{-1}**	**71.6**
Other Inventory[h]																				
Rubble, soil, and equipment[i]	5.86×10^{2}	N/A	2.22	N/A	3.93×10^{4}	N/A	3.34×10^{1}	N/A	6.60×10^{2}	N/A	NR	N/A	NR	N/A	NR	N/A	NR	N/A	NR	N/A
Air Emissions																				
Treatment air emissions[j]	NR	N/A	1.34×10^{3}	N/A	NR	N/A	NR	N/A	NR	N/A	NR	N/A	1.37×10^{3}	N/A	NR	N/A	NR	N/A	NR	N/A

[a] Source of BBI data is *Inventory and Source Term Data Package*, DOE-ORP-2003-02, Rev. 0 (DOE 2003a).
[b] Represents 99.0 percent retrieval. For analysis purposes, waste inventories from tank waste retrieval leaks and ancillary equipment were assumed to be treated in the Waste Treatment Plant and via supplemental treatment processes.
[c] To be stored on site until disposition decisions are made and implemented. This inventory would include the retired HLW melters.
[d] Includes secondary liquids that would be sent to the ETF and treated; solids would be disposed of in an Integrated Disposal Facility.
[e] Includes solid LLW and MLLW streams that would be generated by the waste treatment operations. Such waste streams would include debris waste, melter consumables, failed process components, analytical laboratory waste, spent resins, spent carbon adsorbent, high-efficiency particulate air filters, and other process-related waste. Excludes contaminated liquid effluent waste streams, which would be treated at the ETF.
[f] Tank TRU waste would be disposed of in the Waste Isolation Pilot Plant.
[g] Totals may exceed 100 percent due to conservative estimates or rounded numbers. BBI percentages were rounded to the nearest tenth. The organic chemicals (acetonitrile, benzene, butanol, PCBs, and 2,4,6-TCP) may not total 100 percent because they would be destroyed during the thermal treatment processes. Nitrate may not total 100 percent because it would be volatilized and released through the facility stack.
[h] No chemical constituents of potential concern have been reported in the cesium and strontium capsule secondary-waste streams.
[i] Rubble, soil, and equipment would be generated by removal of 4.6 meters (15 feet) of soil and ancillary equipment at the BX and SX tank farms. Disposal would take place in the River Protection Project Disposal Facility.
[j] Includes air emissions from all waste treatment processes, including those from treatment of the cesium and strontium capsules. For analysis purposes, both mercury capture and air emission releases were assumed.

Note: To convert kilograms to pounds, multiply by 2.2046.
Key: %=percent; BBI=Best-Basis Inventory; butanol=n-butyl alcohol; ETF=Effluent Treatment Facility; HLW=high-level radioactive waste; IHLW=immobilized high-level radioactive waste; ILAW=immobilized low-activity waste; Kg=kilograms; LAW=low-activity waste; LLW=low-level radioactive waste; MLLW=mixed low-level radioactive waste; N/A=not applicable; NR=not reported; PCB=polychlorinated biphenyl; TCP=trichlorophenol; TRU=transuranic.
Source: SAIC 2011.

Table D–45. Tank Closure Alternative 3C Radioactive Constituents of Potential Concern Balance

	Iodine-129		Cesium-137		Carbon-14		Hydrogen-3 (Tritium)		Uranium-233, -234, -235, -238		Neptunium-237		Plutonium -239, -240		Strontium-90		Technetium-99	
	Curies	% of BBI	Curies	% of BBI	Curies	% of BBI	Curies	% of BBI	Curies	% of BBI	Curies	% of BBI	Curies	% of BBI	Curies	% of BBI	Curies	% of BBI
Best-Basis Inventory																		
BBI[a]	4.82×10^{1}	N/A	4.58×10^{7}	N/A	3.12×10^{3}	N/A	1.21×10^{4}	N/A	9.38×10^{2}	N/A	1.41×10^{2}	N/A	8.14×10^{4}	N/A	5.05×10^{7}	N/A	2.97×10^{4}	N/A
Tank Closure Waste Inventory																		
Tank residual waste[b]	4.82×10^{-1}	1.0	4.58×10^{5}	1.0	3.12×10^{1}	1.0	1.21×10^{2}	1.0	9.38	1.0	1.41	1.0	8.14×10^{2}	1.0	5.05×10^{5}	1.0	2.97×10^{2}	1.0
IHLW glass[c]	1.32×10^{-5}	0.0	4.04×10^{7}	88.1	0	0.0	0	0.0	8.32×10^{2}	88.6	1.38×10^{2}	97.8	7.31×10^{4}	89.8	4.87×10^{7}	96.4	1.49×10^{2}	0.5
ILAW glass and retired LAW melters	2.80	5.8	1.73×10^{5}	0.4	0	0.0	0	0.0	1.63×10^{1}	1.7	2.48×10^{-3}	0.0	4.33×10^{-1}	0.0	6.91×10^{2}	0.0	8.44×10^{3}	28.4
ETF-generated solid secondary waste[d]	3.69×10^{1}	76.5	1.44×10^{1}	0.0	4.74	0.2	0	0.0	7.92×10^{-2}	0.0	5.13×10^{-2}	0.0	8.40×10^{-4}	0.0	5.35×10^{1}	0.0	4.63×10^{1}	0.2
Solid secondary waste[e]	1.36	2.8	1.75×10^{5}	0.4	0	0.0	0	0.0	3.33	0.4	2.79×10^{-1}	0.2	1.80×10^{2}	0.2	7.67×10^{5}	1.5	1.28×10^{2}	0.4
200-East Area steam reforming waste	3.67	7.6	2.28×10^{5}	0.5	0	0.0	0	0.0	2.13×10^{1}	2.3	3.25×10^{-3}	0.0	5.68×10^{-1}	0.0	9.10×10^{2}	0.0	1.12×10^{4}	37.8
200-West Area steam reforming waste	3.08	6.4	4.41×10^{6}	9.6	0	0.0	0	0.0	3.01×10^{1}	3.2	9.58×10^{-1}	0.7	1.04×10^{3}	1.3	4.61×10^{5}	0.9	9.42×10^{3}	31.7
Transuranic waste[f]	5.02×10^{-2}	0.1	3.41×10^{5}	0.7	3.85	0.1	3.33	0.0	4.67×10^{1}	5.0	9.79×10^{-1}	0.7	7.39×10^{3}	9.1	7.52×10^{5}	1.5	3.36×10^{2}	1.1
Total[g]	**4.83×10^{1}**	**100.3**	**4.62×10^{7}**	**100.7**	**3.98×10^{1}**	**1.3**	**1.24×10^{2}**	**1.0**	**9.59×10^{2}**	**102.2**	**1.42×10^{2}**	**100.4**	**8.26×10^{4}**	**101.4**	**5.12×10^{7}**	**101.3**	**3.00×10^{4}**	**101.1**
Other Inventory																		
Solid and liquid secondary waste from cesium and strontium capsules	0	N/A	1.99×10^{5}	N/A	0	N/A	0	N/A	0	N/A	0	N/A	0	N/A	3.16×10^{5}	N/A	0	N/A
Cesium and strontium capsules[h]	0	N/A	4.59×10^{7}	N/A	0	N/A	0	N/A	0	N/A	0	N/A	0	N/A	1.98×10^{7}	N/A	0	N/A
Rubble, soil, and equipment[i]	1.67×10^{-2}	N/A	1.31×10^{4}	N/A	1.47	N/A	6.03	N/A	4.82×10^{-1}	N/A	3.24×10^{-2}	N/A	4.32×10^{1}	N/A	3.05×10^{4}	N/A	9.72	N/A
Air Emissions																		
Treatment air emissions[j]	4.78×10^{1}	N/A	4.69×10^{4}	N/A	3.10×10^{3}	N/A	1.19×10^{4}	N/A	4.52×10^{-1}	N/A	NR	N/A	3.72×10^{1}	N/A	3.54×10^{4}	N/A	1.47×10^{1}	N/A

[a] Source of BBI data is *Inventory and Source Term Data Package*, DOE-ORP-2003-02, Rev. 0 (DOE 2003a).

[b] Represents 99.0 percent retrieval. For analysis purposes, waste inventories from tank waste retrieval leaks and ancillary equipment were assumed to be treated in the Waste Treatment Plant and via supplemental treatment processes.

[c] To be stored on site until disposition decisions are made and implemented. This inventory would include the retired HLW melters.

[d] Includes secondary liquids that would be sent to the ETF and treated; solids would be disposed of in an Integrated Disposal Facility. Excludes liquid secondary waste from the processing of cesium and strontium capsules, which would be reported separately.

[e] Includes solid low-level radioactive waste and mixed low-level radioactive waste streams that would be generated by the waste treatment operations. Such waste streams would include debris waste, melter consumables, failed process components, analytical laboratory waste, spent resins, spent carbon adsorbent, high-efficiency particulate air filters, and other process-related waste. Excludes contaminated liquid effluent waste streams, which would be treated at the ETF.

[f] Tank transuranic waste would be disposed of in the Waste Isolation Pilot Plant.

[g] Totals may exceed 100 percent due to conservative estimates or rounded numbers. BBI percentages were rounded to the nearest tenth. Carbon-14 and hydrogen-3 (tritium) may not total 100 percent; a portion of each would be released to the offgas streams and stack, and a portion (ETF-generated liquid) would be disposed of in the State-Approved Land Disposal Site.

[h] To be treated in the Waste Treatment Plant, resulting in glass waste, which would be stored on site until disposition decisions are made and implemented.

[i] Rubble, soil, and equipment would be generated by removal of 4.6 meters (15 feet) of soil and ancillary equipment at the BX and SX tank farms. Disposal would take place in the River Protection Project Disposal Facility.

[j] Includes air emissions from all waste treatment processes, including those from treatment of the cesium and strontium capsules. For analysis purposes, both iodine-129 capture and air emission releases were assumed for the appropriate treatment processes.

Key: %=percent; BBI=Best-Basis Inventory; ETF=Effluent Treatment Facility; HLW=high-level radioactive waste; IHLW=immobilized high-level radioactive waste; ILAW=immobilized low-activity waste; LAW=low-activity waste; N/A=not applicable; NR=not reported.

Source: SAIC 2011.

Table D–46. Tank Closure Alternative 3C Chemical Constituents of Potential Concern Balance

	Chromium		Mercury		Nitrate		Lead		Total Uranium		Acetonitrile		Benzene		Butanol		PCBs		2,4,6-TCP	
	Kg	% of BBI	Kg	% of BBI	Kg	% of BBI	Kg	% of BBI	Kg	% of BBI	Kg	% of BBI	Kg	% of BBI	Kg	% of BBI	Kg	% of BBI	Kg	% of BBI
Best-Basis Inventory																				
BBI[a]	5.98×10^{5}	N/A	1.83×10^{3}	N/A	7.08×10^{7}	N/A	8.41×10^{4}	N/A	5.97×10^{5}	N/A	2.95×10^{4}	N/A	2.40	N/A	3.45×10^{6}	N/A	1.68×10^{3}	N/A	1.11	N/A
Tank Closure Waste Inventory																				
Tank residual waste[b]	5.98×10^{3}	1.0	1.83×10^{1}	1.0	7.08×10^{5}	1.0	8.41×10^{2}	1.0	5.97×10^{3}	1.0	2.95×10^{2}	1.0	2.40×10^{-2}	1.0	3.45×10^{4}	1.0	1.68×10^{1}	1.0	1.11×10^{-2}	1.0
IHLW glass[c]	1.12×10^{5}	18.6	0	0.0	0	0.0	7.07×10^{4}	84.1	5.11×10^{5}	85.5	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
ILAW glass and retired LAW melters	1.34×10^{5}	22.4	0	0.0	0	0.0	2.67×10^{3}	3.2	1.13×10^{4}	1.9	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
ETF-generated solid secondary waste[d]	2.72×10^{1}	0.0	5.54	0.3	9.18×10^{6}	13.0	7.56×10^{2}	0.9	6.39×10^{1}	0.0	NR	N/A	NR	N/A	NR	N/A	NR	N/A	NR	N/A
Solid secondary waste[e]	8.03×10^{2}	0.1	1.75×10^{3}	96.0	0	0.0	2.17×10^{2}	0.3	2.05×10^{3}	0.3	NR	N/A	NR	N/A	NR	N/A	NR	N/A	NR	N/A
200-East Area steam reforming waste	1.76×10^{5}	29.3	0	0	0	0.0	3.16×10^{3}	3.8	1.48×10^{4}	2.5	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
200-West Area steam reforming waste	1.49×10^{5}	24.9	0	0	0	0.0	3.58×10^{3}	4.3	1.99×10^{4}	3.3	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
TRU waste[f]	2.83×10^{4}	4.7	$3.46\times\times10^{1}$	1.9	1.07×10^{6}	1.5	6.43×10^{3}	7.7	5.92×10^{4}	9.9	5.93×10^{2}	2.0	4.83×10^{-2}	2.0	6.95×10^{4}	2.0	3.51×10^{1}	2.1	2.23×10^{-2}	2.0
Total[g]	**6.05×10^{5}**	**101.1**	**1.81×10^{3}**	**99.2**	**1.10×10^{7}**	**15.5**	**8.84×10^{4}**	**105.1**	**6.24×10^{5}**	**104.5**	**8.88×10^{2}**	**3.0**	**7.24×10^{-2}**	**3.0**	**1.04×10^{5}**	**3.0**	**5.19×10^{1}**	**3.1**	**3.34×10^{-2}**	**3.0**
Other Inventory[h]																				
Rubble, soil, and equipment[i]	5.86×10^{2}	N/A	2.22	N/A	3.93×10^{4}	N/A	3.34×10^{1}	N/A	6.60×10^{2}	N/A	NR	N/A	NR	N/A	NR	N/A	NR	N/A	NR	N/A
Air Emissions																				
Treatment air emissions[j]	NR	N/A	1.80×10^{3}	N/A	NR	N/A	NR	N/A	NR	N/A	NR	N/A	3.16×10^{2}	N/A	NR	N/A	NR	N/A	NR	N/A

[a] Source of BBI data is *Inventory and Source Term Data Package*, DOE-ORP-2003-02, Rev. 0 (DOE 2003a).
[b] Represents 99.0 percent retrieval. For analysis purposes, waste inventories from tank waste retrieval leaks and ancillary equipment were assumed to be treated in the Waste Treatment Plant and via supplemental treatment processes.
[c] To be stored on site until disposition decisions are made and implemented. This inventory would include the retired HLW melters.
[d] Includes secondary liquids that would be sent to the ETF and treated; solids would be disposed of in an Integrated Disposal Facility.
[e] Includes solid LLW and MLLW streams that would be generated by the waste treatment operations. Such waste streams would include debris waste, melter consumables, failed process components, analytical laboratory waste, spent resins, spent carbon adsorbent, high-efficiency particulate air filters, and other process-related waste. Excludes contaminated liquid effluent waste streams, which would be treated at the ETF.
[f] Tank TRU waste would be disposed of in the Waste Isolation Pilot Plant.
[g] Totals may exceed 100 percent due to conservative estimates or rounded numbers. BBI percentages were rounded to the nearest tenth. The organic chemicals (acetonitrile, benzene, butanol, PCBs, and 2,4,6-TCP) may not total 100 percent because they would be destroyed during the thermal treatment processes. Nitrate may not total 100 percent because it would be volatilized and released through the facility stack.
[h] No chemical constituents of potential concern have been reported in the cesium and strontium capsule secondary-waste streams.
[i] Rubble, soil, and equipment would be generated by removal of 4.6 meters (15 feet) of soil and ancillary equipment at the BX and SX tank farms. Disposal would take place in the River Protection Project Disposal Facility.
[j] Includes only inventories from facility air emissions, including those from treatment of cesium and strontium capsules. For analysis purposes, both mercury capture and air emission releases were assumed for the appropriate treatment processes.

Note: To convert kilograms to pounds multiply by 2.2046.
Key: %=percent; BBI=Best-Basis Inventory; butanol=n-butyl alcohol; ETF=Effluent Treatment Facility; HLW=high-level radioactive waste; IHLW=immobilized high-level radioactive waste; ILAW=immobilized low-activity waste; Kg=kilograms; LAW=low-activity waste; LLW=low-level radioactive waste; MLLW=mixed low-level radioactive waste; N/A=not applicable; NR=not reported; PCB=polychlorinated biphenyl; TCP=trichlorophenol; TRU=transuranic.
Source: SAIC 2011.

Under Tank Closure Alternative 4, the primary-waste forms produced would be IHLW glass, ILAW glass, and a combination of the supplemental-waste forms; i.e., bulk vitrification glass and cast stone waste. The majority of technetium-99 would be immobilized in the ILAW glass and supplemental-waste forms. Under Tank Closure Alternative 4, the ILAW glass, bulk vitrification glass, cast stone waste, and secondary waste would contain 5.8 percent, 6.5 percent, 38.7 percent, and 49.2 percent, respectively, of the BBI estimate for iodine-129. A process flowsheet is presented in Figure D–7, and material balances under Alternative 4 are presented in Tables D–47 and D–48.

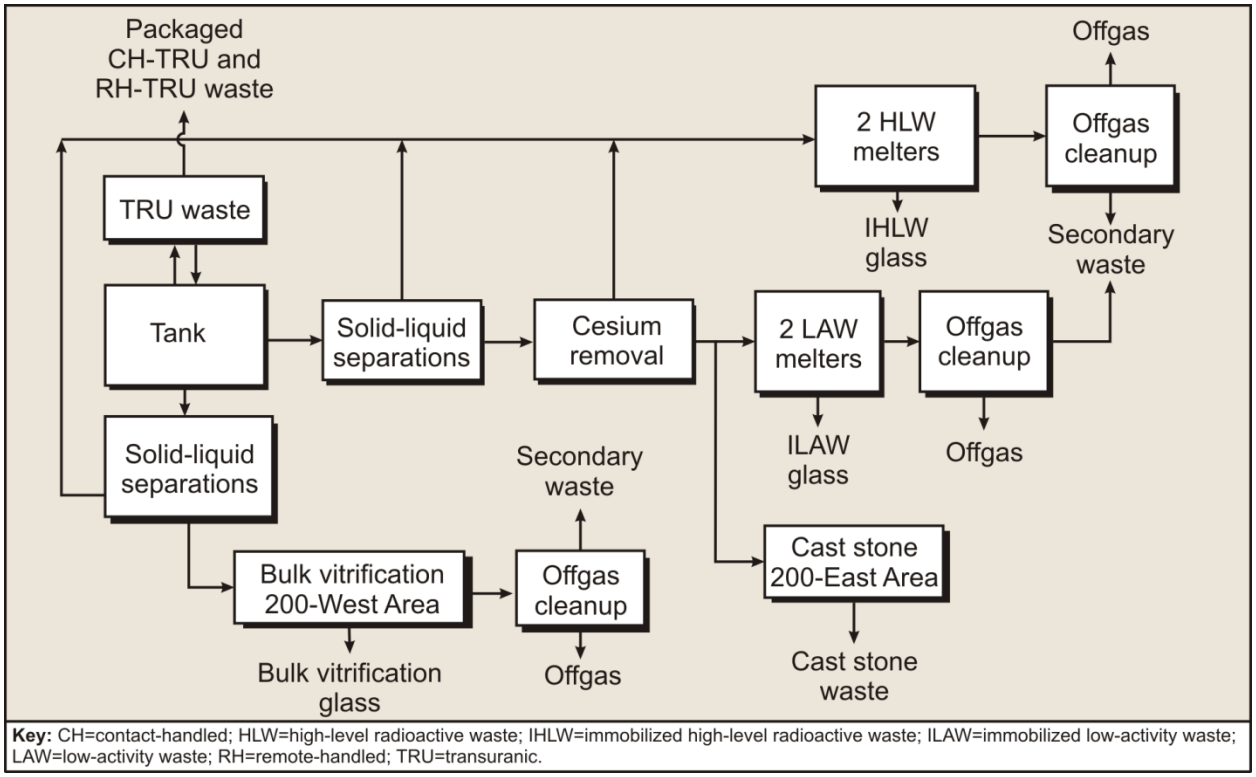


Figure D–7. Tank Closure Alternative 4 Flowsheet

Table D–47. Tank Closure Alternative 4 Radioactive Constituents of Potential Concern Balance

	Iodine-129		Cesium-137		Carbon-14		Hydrogen-3 (Tritium)		Uranium-233, -234, -235, -238		Neptunium-237		Plutonium -239, -240		Strontium-90		Technetium-99	
	Curies	% of BBI	Curies	% of BBI	Curies	% of BBI	Curies	% of BBI	Curies	% of BBI	Curies	% of BBI	Curies	% of BBI	Curies	% of BBI	Curies	% of BBI
Best-Basis Inventory																		
BBI[a]	4.82×10^{1}	N/A	4.58×10^{7}	N/A	3.12×10^{3}	N/A	1.21×10^{4}	N/A	9.38×10^{2}	N/A	1.41×10^{2}	N/A	8.14×10^{4}	N/A	5.05×10^{7}	N/A	2.97×10^{4}	N/A
Tank Closure Waste Inventory																		
Tank residual waste[b]	4.82×10^{-2}	0.1	4.58×10^{4}	0.1	3.12	0.1	1.21×10^{1}	0.1	9.38×10^{-1}	0.1	1.41×10^{-1}	0.1	8.14×10^{1}	0.1	5.05×10^{4}	0.1	2.97×10^{1}	0.1
IHLW glass[c, d]	6.55×10^{-3}	0.0	4.08×10^{7}	89.1	0	0.0	0	0.0	8.41×10^{2}	89.6	1.39×10^{2}	98.7	7.40×10^{4}	90.9	4.93×10^{7}	97.6	1.70×10^{2}	0.6
ILAW glass and retired LAW melters[d]	2.81	5.8	2.39×10^{5}	0.5	0	0.0	0	0.0	2.01×10^{1}	2.1	9.80×10^{-2}	0.1	6.17	0.0	1.41×10^{4}	0.0	8.48×10^{3}	28.5
ETF-generated solid secondary waste[e]	2.24×10^{1}	46.4	1.36×10^{1}	0	3.62	0.1	0	0.0	6.71×10^{-2}	0.0	5.20×10^{-2}	0.0	9.47×10^{-4}	0.0	5.49×10^{1}	0.0	3.53×10^{1}	0.1
Solid secondary waste[f]	1.37	2.8	1.77×10^{5}	0.4	0	0.0	0	0.0	3.38	0.4	2.82×10^{-1}	0.2	1.82×10^{2}	0.2	7.76×10^{5}	1.5	1.28×10^{2}	0.4
200-East Area cast stone waste	1.86×10^{1}	38.7	2.31×10^{5}	0.5	1.18×10^{3}	37.9	4.66×10^{3}	38.7	2.17×10^{1}	2.3	3.30×10^{-3}	0.0	5.77×10^{-1}	0.0	9.23×10^{2}	0.0	1.14×10^{4}	38.4
200-West Area BV glass[g]	3.11	6.5	4.39×10^{6}	9.6	0	0.0	0	0.0	3.03×10^{1}	3.2	9.66×10^{-1}	0.7	1.05×10^{3}	1.3	4.65×10^{5}	0.9	9.50×10^{3}	32.0
Transuranic waste[h]	5.07×10^{-2}	0.1	3.44×10^{5}	0.8	3.88	0.1	3.36	0.0	4.71×10^{1}	5.0	9.88×10^{-1}	0.7	7.46×10^{3}	9.2	7.59×10^{5}	1.5	3.39×10^{2}	1.1
Total[i]	**4.84×10^{1}**	**100.4**	**4.63×10^{7}**	**100.9**	**1.19×10^{3}**	**38.2**	**4.68×10^{3}**	**38.8**	**9.64×10^{2}**	**102.7**	**1.42×10^{2}**	**100.5**	**8.28×10^{4}**	**101.7**	**5.14×10^{7}**	**101.7**	**3.01×10^{4}**	**101.2**
Other Inventory																		
Solid and liquid secondary waste from cesium and strontium capsules	0	N/A	1.99×10^{5}	N/A	0	N/A	0	N/A	0	N/A	0	N/A	0	N/A	3.16×10^{5}	N/A	0	N/A
Cesium and strontium capsules[j]	0	N/A	4.59×10^{7}	N/A	0	N/A	0	N/A	0	N/A	0	N/A	0	N/A	1.98×10^{7}	N/A	0	N/A
PPF secondary waste and rubble, soil, and equipment[k]	5.84×10^{-2}	N/A	9.01×10^{4}	N/A	1.07×10^{1}	N/A	7.19×10^{1}	N/A	5.16	N/A	1.36×10^{-1}	N/A	5.59×10^{1}	N/A	5.41×10^{4}	N/A	3.14×10^{1}	N/A
Air Emissions																		
Treatment air emissions[l]	2.96×10^{1}	N/A	4.70×10^{4}	N/A	1.95×10^{3}	N/A	7.46×10^{3}	N/A	4.48×10^{-1}	N/A	NR	N/A	3.77×10^{1}	N/A	3.58×10^{4}	N/A	9.26	N/A

a Source of BBI data is *Inventory and Source Term Data Package*, DOE-ORP-2003-02, Rev. 0 (DOE 2003a).
b Represents 99.9 percent retrieval. For analysis purposes, waste inventories from tank waste retrieval leaks and ancillary equipment were assumed to be treated in the Waste Treatment Plant and via supplemental treatment processes.
c To be stored on site until disposition decisions are made and implemented. This inventory would include the retired HLW melters.
d Includes PPF contribution from clean closure of BX and SX tank farms.
e Includes secondary liquids that would be sent to the ETF and treated; solids would be disposed of in an Integrated Disposal Facility. Excludes liquid secondary waste from the processing of cesium and strontium capsules, which would be reported separately.
f Includes solid low-level radioactive waste and mixed low-level radioactive waste streams that would be generated by waste treatment operations. Such waste streams would include debris waste, melter consumables, failed process components, analytical laboratory waste, spent resins, spent carbon adsorbent, high-efficiency particulate air filters, and other process-related waste. Excludes contaminated liquid effluent waste streams, which would be treated at the ETF.
g Includes technetium-99 inventory that resides in the BV waste container insulating material or waste container.
h Tank transuranic waste would be disposed of in the Waste Isolation Pilot Plant.
i Totals may exceed 100 percent due to conservative estimates or rounded numbers. BBI of percentages were rounded to the nearest tenth. Carbon-14 and hydrogen-3 (tritium) may not total 100 percent; a portion of each would be released to the offgas streams and stack, and a portion (ETF-generated liquid) would be disposed of in the State-Approved Land Disposal Site.
j To be treated in the Waste Treatment Plant, resulting in glass waste, which would be stored on site until disposition decisions are made and implemented.
k Rubble, soil, and equipment would be generated by clean closure of the BX and SX tank farms. Disposal would take place in the River Protection Project Disposal Facility.
l Includes air emissions from all waste treatment processes, including those from treatment of the cesium and strontium capsules. For analysis purposes, both iodine-129 capture and air emission releases were assumed.

Key: %=percent; BBI=Best-Basis Inventory; BV=bulk vitrification; ETF=Effluent Treatment Facility; HLW=high-level radioactive waste; IHLW=immobilized high-level radioactive waste; ILAW=immobilized low-activity waste; LAW=low-activity waste; N/A=not applicable; NR=not reported; PPF=Preprocessing Facility.

Source: SAIC 2011.

Table D–48. Tank Closure Alternative 4 Chemical Constituents of Potential Concern Balance

	Chromium		Mercury		Nitrate		Lead		Total Uranium		Acetonitrile		Benzene		Butanol		PCBs		2,4,6-TCP	
	Kg	% of BBI	Kg	% of BBI	Kg	% of BBI	Kg	% of BBI	Kg	% of BBI	Kg	% of BBI	Kg	% of BBI	Kg	% of BBI	Kg	% of BBI	Kg	% of BBI
Best-Basis Inventory																				
BBI[a]	5.98×10^{5}	N/A	1.83×10^{3}	N/A	7.08×10^{7}	N/A	8.41×10^{4}	N/A	5.97×10^{5}	N/A	2.95×10^{4}	N/A	2.40	N/A	3.45×10^{6}	N/A	1.68×10^{3}	N/A	1.11	N/A
Tank Closure Waste Inventory																				
Tank residual waste[b]	5.98×10^{2}	0.1	1.83	0.1	7.08×10^{4}	0.1	8.41×10^{1}	0.1	5.97×10^{2}	0.1	2.95×10^{1}	0.1	2.40×10^{-3}	0.1	3.45×10^{3}	0.1	1.68	0.1	1.11×10^{-3}	0.1
IHLW glass[c, d]	1.16×10^{5}	19.4	0	0.0	0	0.0	7.14×10^{4}	84.9	5.15×10^{5}	86.3	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
ILAW glass and retired LAW melters	1.35×10^{5}	22.6	0	0.0	0	0.0	2.27×10^{3}	3.3	1.31×10^{4}	2.2	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
ETF-generated solid secondary waste[e]	2.31×10^{1}	0.0	4.86	0.3	5.20×10^{6}	7.3	4.08×10^{2}	0.5	5.60×10^{1}	0.0	NR	N/A	NR	N/A	NR	N/A	NR	N/A	NR	N/A
Solid secondary waste[f]	8.22×10^{2}	0.1	1.54×10^{3}	84.2	0	0.0	2.20×10^{2}	0.3	2.08×10^{3}	0.3	NR	N/A	NR	N/A	NR	N/A	NR	N/A	NR	N/A
200-East Area cast stone waste	1.78×10^{5}	29.8	2.44×10^{2}	13.4	2.73×10^{7}	38.6	3.57×10^{3}	4.2	1.50×10^{4}	2.5	1.12×10^{4}	37.9	9.11×10^{-1}	37.9	1.31×10^{6}	37.9	6.39	0.4	4.20×10^{-1}	37.9
200-West Area BV glass	1.49×10^{5}	25.0	0	0.0	0	0.0	3.59×10^{3}	4.3	1.99×10^{4}	3.3	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
TRU waste[g]	2.86×10^{4}	4.8	3.49×10^{1}	1.9	1.08×10^{6}	1.5	6.49×10^{3}	7.7	5.98×10^{4}	10.0	5.99×10^{2}	2.0	4.88×10^{-2}	2.0	7.01×10^{4}	2.0	3.54×10^{1}	2.1	2.25×10^{-2}	2.0
Total[h]	**6.09×10^{5}**	**101.7**	**1.82×10^{3}**	**99.9**	**3.37×10^{7}**	**47.5**	**8.86×10^{4}**	**105.3**	**6.26×10^{5}**	**104.8**	**1.18×10^{4}**	**40.1**	**9.62×10^{-1}**	**40.1**	**1.38×10^{6}**	**40.1**	**4.35×10^{1}**	**2.6**	**4.44×10^{-1}**	**40.1**
Other Inventory[i]																				
PPF secondary waste[j] and rubble, soil, and equipment[k]	1.86×10^{3}	N/A	1.28	N/A	7.78×10^{4}	N/A	4.27×10^{1}	N/A	4.85×10^{3}	N/A	NR	N/A	NR	N/A	2.68	N/A	1.64×10^{-1}	N/A	NR	N/A
Air Emissions																				
Treatment air emissions[l]	NR	N/A	1.64×10^{3}	N/A	NR	N/A	NR	N/A	NR	N/A	NR	N/A	8.78×10^{2}	N/A	NR	N/A	NR	N/A	NR	N/A

[a] Source of BBI data is *Inventory and Source Term Data Package*, DOE-ORP-2003-02, Rev. 0 (DOE 2003a).
[b] Represents 99.9 percent retrieval. For analysis purposes, waste inventories from tank waste retrieval leaks and ancillary equipment were assumed to be treated in the Waste Treatment Plant and via supplemental treatment processes.
[c] To be stored on site until disposition decisions are made and implemented. This inventory would include the retired HLW melters.
[d] Includes PPF contribution from clean closure of the BX and SX tank farms.
[e] Includes secondary liquids that would be sent to the ETF and treated; solids would be disposed of in an Integrated Disposal Facility.
[f] Includes solid low-level radioactive waste and mixed low-level radioactive waste streams that would be generated by waste treatment operations. Such waste streams would include debris waste, melter consumables, failed process components, analytical laboratory waste, spent resins, spent carbon adsorbent, high-efficiency particulate air filters, and other process-related waste. Excludes contaminated liquid effluent waste streams, which would be treated at the ETF.
[g] Tank TRU waste would be disposed of in the Waste Isolation Pilot Plant.
[h] Totals may exceed 100 percent due to conservative estimates or rounded numbers. BBI percentages were rounded to the nearest tenth. The organic chemicals (acetonitrile, benzene, butanol, PCBs, and 2,4,6-TCP) may not total 100 percent because they would be destroyed during the thermal treatment processes. Nitrate may not total 100 percent because it would be volatilized and released through the facility stack.
[i] No chemical constituents of potential concern have been reported in the cesium and strontium capsule secondary-waste streams.
[j] Includes the solid secondary mixed low-level radioactive waste stream generated by the PPF and the solid waste generated from treating PPF liquid and solid secondary waste, as well as solid secondary waste. Disposal would take place in the River Protection Project Disposal Facility.
[k] Rubble, soil, and equipment would be generated by clean closure of the BX and SX tank farms. Disposal would take place in the River Protection Project Disposal Facility.
[l] Includes air emissions from all waste treatment processes, including those from treatment of the cesium and strontium capsules. For analysis purposes, both mercury capture and air emission releases were assumed.

Note: To convert kilograms to pounds, multiply by 2.2046.
Key: %=percent; BBI=Best-Basis Inventory; butanol=n-butyl alcohol; BV=bulk vitrification; ETF=Effluent Treatment Facility; HLW=high-level radioactive waste; IHLW=immobilized high-level radioactive waste; ILAW=immobilized low-activity waste; Kg=kilograms; LAW=low-activity waste; N/A=not applicable; NR=not reported; PCB=polychlorinated biphenyl; PPF=Preprocessing Facility; TCP=trichlorophenol; TRU=transuranic.
Source: SAIC 2011.

In addition, under Tank Closure Alternative 4 (see Figure D–8 for a simplified flowsheet and Tables D–49 and D–50 for inventories), selected tank farms, represented by the BX and SX tank farms, would undergo clean closure. Under clean closure, the SSTs, soils contaminated with leaks from retrieval activities, and soils contaminated by past tank leaks in these two tank farms would be removed. The more highly contaminated portions of the removed materials would be sent to a proposed Preprocessing Facility (PPF) for decontamination.

Under this alternative, it was assumed that 95 percent of the radioactive and chemical constituent inventory remaining in the tanks and ancillary equipment and from leaks associated with waste retrieval would be sent to the PPF, while 5 percent of the inventory would be packaged and sent directly to the River Protection Project Disposal Facility (RPPDF) as mixed low-level radioactive waste (MLLW). It was further assumed that the PPF processes would be effective at removing 85 percent of the contaminants from the rubble, soil, and equipment contaminated with tank waste retrieval leaks from retrieval activities. This treated material would be sent to the WTP, where it would be processed with the HLW stream. The remaining 15 percent would remain with the contaminated rubble, soil, and equipment and would be disposed of as MLLW in the RPPDF. The resulting value would be 14.25 percent (15 percent of 95 percent), rounded to 14 percent. Thus, 19 percent of the inventory of contaminants from the residual waste in the tanks, ancillary equipment, and soil contaminated by tank waste retrieval leaks would be sent to the RPPDF as MLLW (SAIC 2010a).

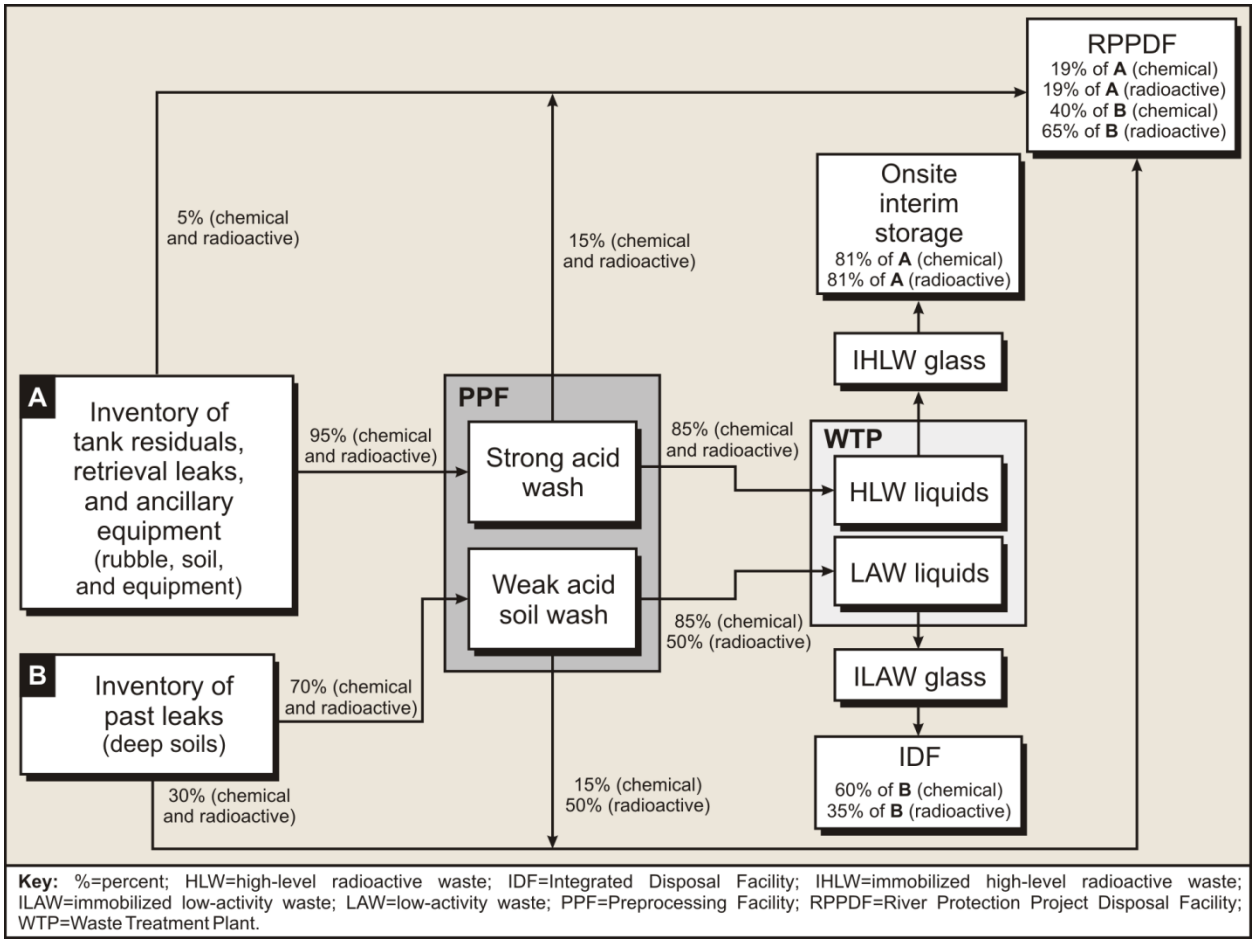


Figure D–8. Tank Closure Alternative 4 Clean Closure of BX and SX Tank Farms Flowsheet

Table D–49. Tank Closure Alternative 4 Radioactive Constituents of Potential Concern Inventory from Clean Closure of BX and SX Tank Farms (curies)

Analyte	MLLW[a]	IHLW Glass[b]	ILAW Glass[c]
Hydrogen-3 (tritium)	7.19×10^{1}	0	0
Carbon-14	1.07×10^{1}	0	0
Strontium-90	5.41×10^{4}	1.69×10^{5}	1.34×10^{4}
Technetium-99	3.14×10^{1}	1.99×10^{1}	2.09×10^{1}
Iodine-129	5.84×10^{-2}	6.55×10^{-3}	8.03×10^{-3}
Cesium-137	9.01×10^{4}	2.86×10^{4}	6.49×10^{4}
Uranium-233, -234, -235, -238	5.16	1.29	3.78
Neptunium-237	1.36×10^{-1}	6.36×10^{-2}	9.54×10^{-2}
Plutonium-239, -240	5.59×10^{1}	2.29×10^{2}	5.73

a Represents 19 percent of the contaminant inventory from the residual waste in tanks, ancillary equipment, and soil contaminated by tank waste retrieval leaks and 65 percent of the contaminant inventory in deep soils for the BX and SX tank farms. Disposal would take place in the River Protection Project Disposal Facility.

b Represents the portion of the 85 percent of the highly contaminated rubble, soil, and equipment (tank and ancillary equipment) contaminant inventory resulting from clean closure of the BX and SX tank farms that would reside in the IHLW glass after treatment in the Waste Treatment Plant. IHLW would be disposed of off site; however, it may remain on site until disposition decisions are made and implemented.

c Represents the portion of the 50 percent of the highly contaminated rubble and soil (deep soil) contaminant inventory resulting from clean closure of the BX and SX tank farms that would reside in the ILAW glass after treatment in the Waste Treatment Plant. Disposal would take place in an Integrated Disposal Facility.

Key: IHLW=immobilized high-level radioactive waste; ILAW=immobilized low-activity waste; MLLW=mixed low-level radioactive waste.

Source: SAIC 2011.

Table D–50. Tank Closure Alternative 4 Chemical Constituents of Potential Concern Inventory from Clean Closure of BX and SX Tank Farms (kilograms)

Analyte	MLLW[a]	IHLW Glass[b]	ILAW Glass[c]
Chromium	1.86×10^{3}	3.33×10^{3}	1.36×10^{3}
Mercury	1.28	0	0
Nitrate	7.78×10^{4}	0	0
Lead	4.27×10^{1}	5.34×10^{1}	9.18×10^{1}
Total uranium	4.85×10^{3}	0	1.79×10^{3}
Acetonitrile	NR	NR	NR
Benzene	NR	NR	NR
Butanol (n-butyl alcohol)	2.68	NR	NR
Polychlorinated biphenyls	1.64×10^{-1}	NR	NR
2,4,6-Trichlorophenol	NR	NR	NR

a Represents 19 percent of the contaminant inventory from the residual waste in tanks, ancillary equipment, and soil contaminated by tank waste retrieval leaks and 40.5 percent of the contaminant inventory in deep soils for the BX and SX tank farms. Disposal would take place in the River Protection Project Disposal Facility.

b Represents the portion of the 85 percent of the highly contaminated rubble, soil, and equipment (tank and ancillary equipment) contaminant inventory resulting from clean closure of the BX and SX tank farms that would reside in the IHLW glass after treatment in the Waste Treatment Plant. IHLW would be disposed of off site; however, it may remain on site until disposition decisions are made and implemented.

c Represents the portion of the 85 percent of the highly contaminated rubble and soil (deep soil) contaminant inventory resulting from clean closure of the BX and SX tank farms that would reside in the ILAW glass after treatment in the Waste Treatment Plant. Disposal would take place in an Integrated Disposal Facility.

Note: To convert kilograms to pounds, multiply by 2.2046.

Key: IHLW=immobilized high-level radioactive waste; ILAW=immobilized low-activity waste; MLLW=mixed low-level radioactive waste; NR=not reported.

Source: SAIC 2011.

Additionally, it was assumed that, after the soil contaminated from past tank leaks (deep soil) has been removed, 30 percent of the radioactive and chemical constituent inventory would be included in materials that would be packaged and sent directly to the RPPDF. The remaining 70 percent of the contaminants would be contained in soils that would be routed to the PPF for soil washing. From this 70 percent, it was assumed that the PPF processes would remove 50 percent of the radioactive contaminants and 85 percent of the chemical contaminants. Those radioactive and chemical contaminants removed in the PPF would be sent to the WTP, where they would be processed into ILAW glass. The remaining contaminants (50 percent radioactive and 15 percent chemical) would reside in the decontaminated soil and would be disposed of in the RPPDF. Thus, a total of 65 percent of the radioactive contaminant inventory resulting from past tank leaks would be disposed of in the RPPDF (30 percent disposed of directly and 35 percent [half of 70 percent] disposed of as MLLW after washing in the PPF). Similarly, a total of 41 percent of the chemical contaminant inventory resulting from past tank leaks would be disposed of in the RPPDF (30 percent disposed of directly and 11 percent [15 percent of 70 percent] disposed of as MLLW after washing in the PPF). The following equations were used to calculate the inventory of contaminants due to contaminated tank materials, rubble, soil, and ancillary equipment from clean closure of the BX and SX SST farms (SAIC 2010a):

$$M\text{rad}_{\text{soil}} = 0.19 \times (M_{\text{TR}-99.9} + M_{\text{retrieval}} + M_{\text{anc}}) + 0.65 \times M_{\text{pleak}}$$

and

$$M\text{chem}_{\text{soil}} = 0.19 \times (M_{\text{TR}-99.9} + M_{\text{retrieval}} + M_{\text{anc}}) + 0.41 \times M_{\text{pleak}}$$

where:

$M\text{rad}_{\text{soil}}$ = inventory of radioactive constituents in contaminated rubble, soil, and equipment disposed of on site

$M_{\text{TR}-99.9}$ = inventory of radioactive or chemical constituents in tank residual waste following removal of 99.9 percent of the inventory

$M_{\text{retrieval}}$ = inventory of radioactive or chemical constituents from tank waste retrieval leaks

M_{anc} = inventory of radioactive or chemical constituents in ancillary equipment

M_{pleak} = inventory of radioactive or chemical constituents in past leaks

$M\text{chem}_{\text{soil}}$ = inventory of chemical constituents in contaminated rubble, soil, and equipment disposed of on site

Processing steps under Tank Closure Alternative 5 would be similar to those under Tank Closure Alternative 4, except that a step for removal of sulfate from the LAW stream feed to the LAW melter would be added. Most of the technetium-99 would be solidified in LAW forms. Under Tank Closure Alternative 5, the ILAW glass, bulk vitrification glass, cast stone waste, and secondary waste would be 9.6 percent, 5.8 percent, 13.2 percent, and 61.6 percent, respectively, of the BBI estimate for iodine-129. The process flowsheet for Tank Closure Alternative 5 is presented in Figure D–9, and material balance summaries are presented in Tables D–51 and D–52.

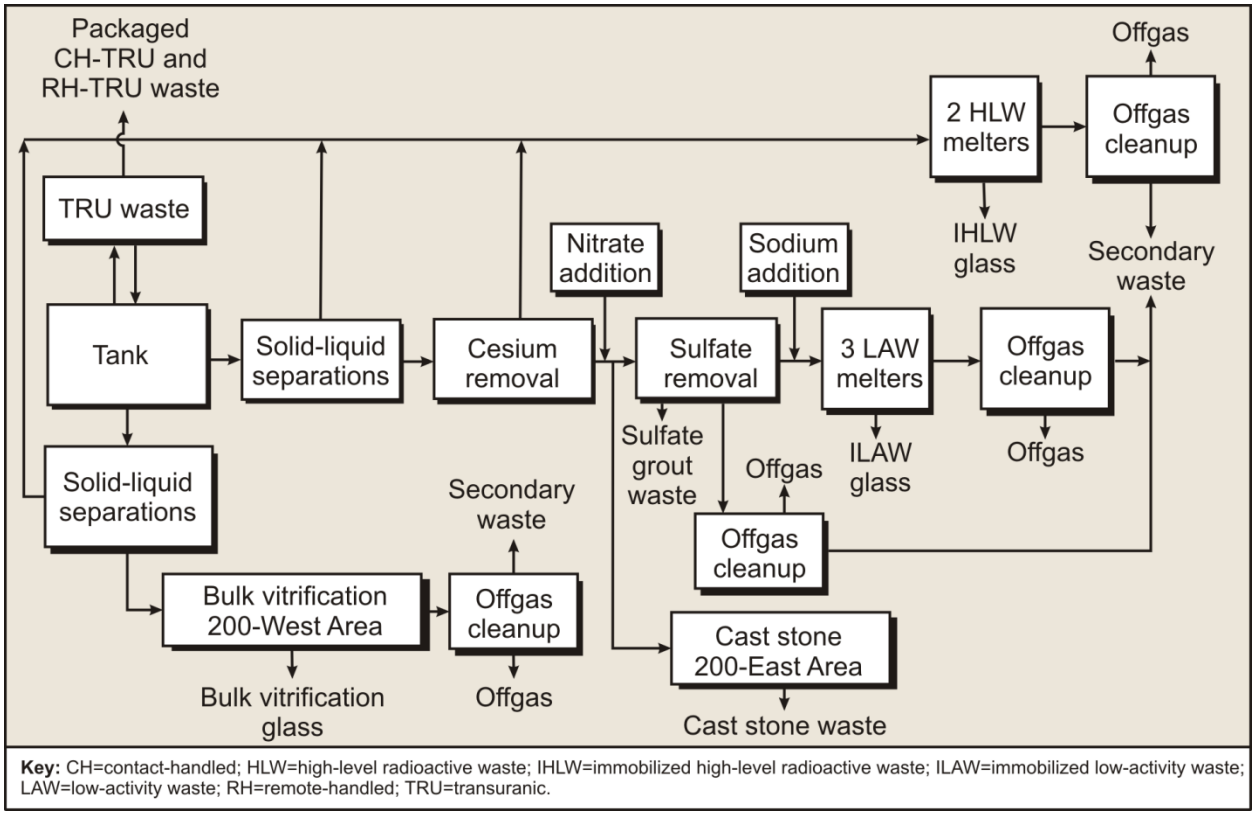


Figure D–9. Tank Closure Alternative 5 Flowsheet

Table D–51. Tank Closure Alternative 5 Radioactive Constituents of Potential Concern Balance

	Iodine-129		Cesium-137		Carbon-14		Hydrogen-3 (Tritium)		Uranium-233, -234, -235, -238		Neptunium-237		Plutonium -239, -240		Strontium-90		Technetium-99	
	Curies	% of BBI	Curies	% of BBI	Curies	% of BBI	Curies	% of BBI	Curies	% of BBI	Curies	% of BBI	Curies	% of BBI	Curies	% of BBI	Curies	% of BBI
Best-Basis Inventory																		
BBI[a]	4.82×10^{1}	N/A	4.58×10^{7}	N/A	3.12×10^{3}	N/A	1.21×10^{4}	N/A	9.38×10^{2}	N/A	1.41×10^{2}	N/A	8.14×10^{4}	N/A	5.05×10^{7}	N/A	2.97×10^{4}	N/A
Tank Closure Waste Inventory																		
Tank residual waste[b]	4.82	10.0	4.58×10^{6}	10.0	3.12×10^{2}	10.0	1.21×10^{3}	10.0	9.38×10^{1}	10.0	1.41×10^{1}	10.0	8.14×10^{3}	10.0	5.05×10^{6}	10.0	2.97×10^{3}	10.0
IHLW glass[c]	1.32×10^{-5}	0.0	3.63×10^{7}	79.2	0	0.0	0	0.0	7.56×10^{2}	80.6	1.25×10^{2}	88.9	6.65×10^{4}	81.6	4.43×10^{7}	87.6	1.35×10^{2}	0.5
ILAW glass and retired LAW melters	4.61	9.6	2.51×10^{5}	0.5	0	0.0	0	0.0	2.67×10^{1}	2.8	3.92×10^{-3}	0.0	6.13×10^{-1}	0.0	1.14×10^{-1}	0.0	1.39×10^{4}	46.8
Sulfate grout waste[d]	0	0.0%	3.11×10^{4}	0.1	0	0.0	0	0.0	0	0.0	1.63×10^{-4}	0.0	9.98×10^{-2}	0.0	1.14×10^{3}	0.0	0	0.0
ETF-generated solid secondary waste[e]	2.74×10^{1}	56.9	1.36×10^{1}	0.0	1.04	0.0	0	0.0	6.07×10^{-2}	0.0	4.68×10^{-2}	0.0	8.51×10^{-4}	0.0	4.95×10^{1}	0.0	5.03×10^{1}	0.2
Solid secondary waste[f]	2.24	4.7	1.58×10^{5}	0.3	0	0.0	0	0.0	3.07	0.3	2.54×10^{-1}	0.2	1.64×10^{2}	0.2	6.97×10^{5}	1.4	2.08×10^{2}	0.7
200-East Area cast stone waste	6.38	13.2	7.82×10^{4}	0.2	4.05×10^{2}	13.0	1.60×10^{3}	13.2	7.41	0.8	1.13×10^{-3}	0.0	1.97×10^{-1}	0.0	3.16×10^{2}	0.0	3.90×10^{3}	13.1
200-West Area BV glass[g]	2.80	5.8	4.39×10^{6}	9.6	0	0.0	0	0.0	2.73×10^{1}	2.9	8.71×10^{-1}	0.6	9.49×10^{2}	1.2	4.19×10^{5}	0.8	8.56×10^{3}	28.8
TRU waste[h]	4.57×10^{-2}	0.1	3.10×10^{5}	0.7	3.50	0.1	3.03	0.0	4.24×10^{1}	4.5	8.90×10^{-1}	0.6	6.72×10^{3}	8.2	6.84×10^{5}	1.4	3.06×10^{2}	1.0
Total[i]	**4.83×10^{1}**	**100.3**	**4.61×10^{7}**	**100.6**	**7.22×10^{2}**	**23.1**	**2.80×10^{3}**	**23.3**	**9.57×10^{2}**	**102.0**	**1.42×10^{2}**	**100.4**	**8.25×10^{4}**	**101.2**	**5.11×10^{7}**	**101.2**	**3×10^{4}**	**101.1**
Other Inventory																		
Solid and liquid secondary waste from cesium and strontium capsules	0	N/A	1.99×10^{5}	N/A	0	N/A	0	N/A	0	N/A	0	N/A	0	N/A	3.16×10^{5}	N/A	0	N/A
Cesium and strontium capsules[j]	0	N/A	4.59×10^{7}	N/A	0	N/A	0	N/A	0	N/A	0	N/A	0	N/A	1.98×10^{7}	N/A	0	N/A
Air Emissions																		
Treatment air emissions[k]	3.70×10^{1}	N/A	4.47×10^{4}	N/A	2.41×10^{3}	N/A	9.27×10^{3}	N/A	4.07×10^{-1}	N/A	NR	N/A	3.39×10^{1}	N/A	3.32×10^{4}	N/A	1.16×10^{1}	N/A

[a] Source of BBI data is *Inventory and Source Term Data Package*, DOE-ORP-2003-02, Rev. 0 (DOE 2003a).
[b] Represents 90.0 percent retrieval. For analysis purposes, waste inventories from tank waste retrieval leaks and ancillary equipment were assumed to be treated in the Waste Treatment Plant and via supplemental treatment processes.
[c] To be stored on site until disposition decisions are made and implemented. This inventory would include the retired HLW melters.
[d] Generated by removal of sulfate from the ILAW waste stream. Disposal would take place in an Integrated Disposal Facility.
[e] Includes secondary liquids that would be sent to the ETF and treated; solids would be disposed of in an Integrated Disposal Facility. Excludes liquid secondary waste from the processing of cesium and strontium capsules, which would be reported separately.
[f] Includes solid low-level radioactive waste and mixed low-level radioactive waste streams that would be generated by waste treatment operations. Such waste streams would include debris waste, melter consumables, failed process components, analytical laboratory waste, spent resins, spent carbon adsorbent, high-efficiency particulate air filters, and other process-related waste. Excludes contaminated liquid effluent waste streams, which would be treated at the ETF.
[g] Includes technetium-99 inventory that resides in the BV waste container insulating material or waste container.
[h] Tank TRU waste disposal would take place in the Waste Isolation Pilot Plant.
[i] Totals may exceed 100 percent due to conservative estimates or rounded numbers. BBI of percentages were rounded to the nearest tenth. Carbon-14 and hydrogen-3 (tritium) may not total 100 percent; a portion of each would be released to the offgas streams and stack, and a portion (ETF-generated liquid) would be disposed of in the State-Approved Land Disposal Site.
[j] To be treated in the Waste Treatment Plant, resulting in glass waste, which would be stored on site until disposition decisions are made and implemented.
[k] Includes air emissions from all waste treatment processes, including those from treatment of the cesium and strontium capsules. For analysis purposes, both iodine-129 capture and air emission releases were assumed.

Key: %=percent; BBI=Best-Basis Inventory; BV=bulk vitrification; ETF=Effluent Treatment Facility; HLW=high-level radioactive waste; IHLW=immobilized high-level radioactive waste; ILAW=immobilized low-activity waste; LAW=low-activity waste; N/A=not applicable; NR=not reported; TRU=transuranic.
Source: SAIC 2011.

Table D–52. Tank Closure Alternative 5 Chemical Constituents of Potential Concern Balance

	Chromium		Mercury		Nitrate		Lead		Total Uranium		Acetonitrile		Benzene		Butanol		PCBs		2,4,6-TCP	
	Kg	% of BBI	Kg	% of BBI	Kg	% of BBI	Kg	% of BBI	Kg	% of BBI	Kg	% of BBI	Kg	% of BBI	Kg	% of BBI	Kg	% of BBI	Kg	% of BBI
Best-Basis Inventory																				
BBI[a]	5.98×10^{5}	N/A	1.83×10^{3}	N/A	7.08×10^{7}	N/A	8.41×10^{4}	N/A	5.97×10^{5}	N/A	2.95×10^{4}	N/A	2.40	N/A	3.45×10^{6}	N/A	1.68×10^{3}	N/A	1.11	N/A
Tank Closure Waste Inventory																				
Tank residual waste[b]	5.98×10^{4}	10.0	1.83×10^{2}	10.0	7.08×10^{6}	10.0	8.41×10^{3}	10.0	5.97×10^{4}	10.0	2.95×10^{3}	10.0	2.40×10^{-1}	10.0	3.45×10^{5}	10.0	1.68×10^{2}	10.0	1.11×10^{-1}	10.0
IHLW glass[c]	1.01×10^{5}	16.9	0	0.0	0	0.0	6.43×10^{4}	76.5	4.64×10^{5}	77.8	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
ILAW glass and retired LAW melters	2.20×10^{1}	0.0	0	0.0	0	0.0	4.40×10^{-1}	0.0	1.86×10^{4}	3.1	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Sulfate grout waste[d]	2.21×10^{5}	36.9	0	0.0	0	0.0	4.41×10^{3}	5.2	0	0.0	NR	N/A	NR	N/A	NR	N/A	NR	N/A	NR	N/A
ETF-generated solid secondary waste[e]	1.15×10^{1}	0.0	4.77	0.3	1.20×10^{7}	16.9	3.67×10^{2}	0.4	5.09×10^{1}	0.0	NR	N/A	NR	N/A	NR	N/A	NR	N/A	NR	N/A
Solid secondary waste[f]	3.32×10^{2}	0.1	1.51×10^{3}	82.8	0	0.0	1.90×10^{2}	0.2	1.90×10^{3}	0.3	NR	N/A	NR	N/A	NR	N/A	NR	N/A	NR	N/A
200-East Area cast stone waste	6.11×10^{4}	10.2	8.36×10^{1}	4.6	9.35×10^{6}	13.2	1.22×10^{3}	1.5	5.15×10^{3}	0.9	3.71×10^{3}	12.6	3.02×10^{-1}	12.6	4.35×10^{5}	12.6	2.12	0.1	1.39×10^{-1}	12.6
200-West Area BV glass	1.35×10^{5}	22.5	0	0.0	0	0.0	3.23×10^{3}	3.8	1.80×10^{4}	3.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
TRU waste[g]	2.57×10^{4}	4.3	3.15×10^{1}	1.7	9.69×10^{5}	1.4	5.85×10^{3}	7.0	5.38×10^{4}	9.0	5.39×10^{2}	1.8	4.39×10^{-2}	1.8	6.32×10^{4}	1.8	3.19×10^{1}	1.9	2.03×10^{-2}	1.8
Total[h]	**6.03×10^{5}**	**100.8**	**1.81×10^{3}**	**99.4**	**2.94×10^{7}**	**41.5**	**8.80×10^{4}**	**104.6**	**6.21×10^{5}**	**104.1**	**7.20×10^{3}**	**24.4**	**5.86×10^{-1}**	**24.4**	**8.43×10^{5}**	**24.4**	**2.03×10^{2}**	**12.0**	**2.70×10^{-1}**	**24.4**
Other Inventory[i]																				
Treatment air emissions[j]	NR	N/A	1.56×10^{3}	N/A	NR	N/A	NR	N/A	NR	N/A	NR	N/A	1.57×10^{3}	N/A	NR	N/A	NR	N/A	NR	N/A

a Source of BBI data is *Inventory and Source Term Data Package*, DOE-ORP-2003-02, Rev. 0 (DOE 2003a).

b Represents 90.0 percent retrieval. For analysis purposes, waste inventories from tank waste retrieval leaks and ancillary equipment were assumed to be treated in the Waste Treatment Plant and via supplemental treatment processes.

c To be stored on site until disposition decisions are made and implemented. This inventory would include the retired HLW melters.

d Generated by removal of sulfate from the ILAW feed stream. Disposal would take place in an Integrated Disposal Facility.

e Includes secondary liquids that would be sent to the ETF and treated; solids would be disposed of in an Integrated Disposal Facility.

f Includes solid low-level radioactive waste and mixed low-level radioactive waste streams that would be generated by waste treatment operations. Such waste streams would include debris waste, melter consumables, failed process components, analytical laboratory waste, spent resins, spent carbon adsorbent, high-efficiency particulate air filters, and other process-related waste. Excludes contaminated liquid effluent waste streams, which would be treated at the ETF.

g Tank TRU waste would be disposed of in the Waste Isolation Pilot Plant.

h Totals may exceed 100 percent due to conservative estimates or rounded numbers. BBI percentages were rounded to the nearest tenth. The organic chemicals (acetonitrile, benzene, butanol, PCBs, and 2,4,6-TCP) may not total 100 percent because they would be destroyed during thermal treatment processes. Nitrate may not total 100 percent because it would be volatilized and released through the facility stack.

i No chemical constituents of potential concern have been reported in the cesium and strontium capsule secondary-waste streams.

j Includes air emissions from all waste treatment processes, including those from treatment of the cesium and strontium capsules. For analysis purposes, both mercury capture and air emission releases were assumed.

Note: To convert kilograms to pounds, multiply by 2.2046.

Key: %=percent; BBI=Best-Basis Inventory; butanol=n-butyl alcohol; BV=bulk vitrification; ETF=Effluent Treatment Facility; HLW=high-level radioactive waste; IHLW=immobilized high-level radioactive waste; ILAW=immobilized low-activity waste; Kg=kilograms; LAW=low-activity waste; N/A=not applicable; NR=not reported; PCB=polychlorinated biphenyl; TCP=trichlorophenol; TRU=transuranic.

Source: SAIC 2011.

Under Tank Closure Alternative 6 are three subalternatives (6A, 6B, and 6C); two of these alternatives (6A and 6B) have two options: a Base Case and an Option Case. Under Tank Closure Alternative 6A, Base Case, represented in Figure D–10, all waste streams, including those from clean closure of the SSTs, would be managed as IHLW glass. Under Tank Closure Alternative 6A, Option Case, the six sets of contiguous cribs and trenches (ditches) described in Section D.1.5 (the B Cribs, BX Trenches, BY Cribs, T Cribs, T Trenches, and TX Trenches [considered to be one set], and TY Cribs) would be added to the Alternative 6A, Base Case, inventory. Material balance summaries for these two cases are presented in Tables D–53 through D–56.

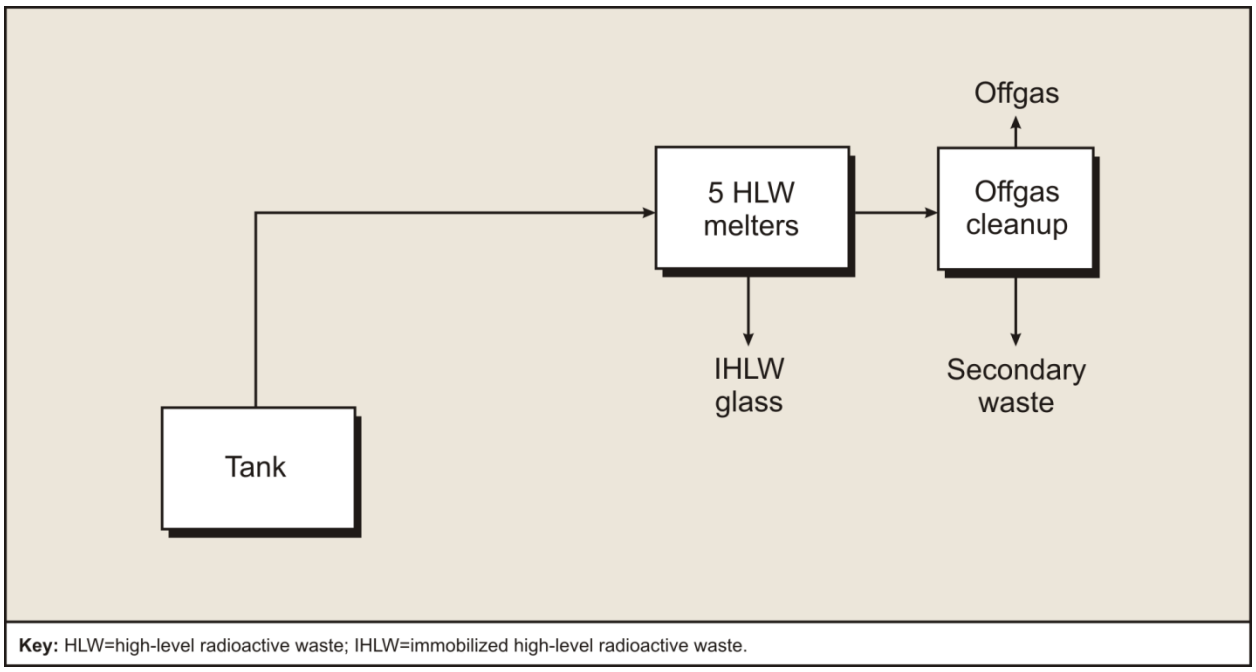


Figure D–10. Tank Closure Alternative 6A Flowsheet

Table D–53. Tank Closure Alternative 6A, Base Case, Radioactive Constituents of Potential Concern Balance

	Iodine-129		Cesium-137		Carbon-14		Hydrogen-3 (Tritium)		Uranium-233, -234, -235, -238		Neptunium-237		Plutonium -239, -240		Strontium-90		Technetium-99	
	Curies	% of BBI	Curies	% of BBI	Curies	% of BBI	Curies	% of BBI	Curies	% of BBI	Curies	% of BBI	Curies	% of BBI	Curies	% of BBI	Curies	% of BBI
Best-Basis Inventory																		
BBI[a]	4.82×10^{1}	N/A	4.58×10^{7}	N/A	3.12×10^{3}	N/A	1.21×10^{4}	N/A	9.38×10^{2}	N/A	1.41×10^{2}	N/A	8.14×10^{4}	N/A	5.05×10^{7}	N/A	2.97×10^{4}	N/A
Tank Closure Waste Inventory																		
Tank residual waste[b]	4.82×10^{-2}	0.1	4.58×10^{4}	0.1	3.12	0.1	1.21×10^{1}	0.1	9.38×10^{-1}	0.1	1.41×10^{-1}	0.1	8.14×10^{1}	0.1	5.05×10^{4}	0.1	2.97×10^{1}	0.1
IHLW glass[c]	9.64	20.0	4.57×10^{7}	99.7	0	0.0	0	0.0	9.36×10^{2}	99.8	1.41×10^{2}	99.9	8.14×10^{4}	99.9	4.98×10^{7}	98.5	2.96×10^{4}	99.6
ETF-generated solid secondary waste[d]	3.41×10^{1}	70.7	4.65×10^{-1}	0.0	8.63	0.3	0	0.0	4.11×10^{-2}	0.0	5.18×10^{-2}	0.0	6.96×10^{-4}	0.0	6.49	0.0	8.74×10^{1}	0.3
Solid secondary waste[e]	4.72	9.8	1.98×10^{5}	0.4	0	0.0	0	0.0	3.70	0.4	2.86×10^{-1}	0.2	2.00×10^{2}	0.2	7.84×10^{5}	1.6	4.37×10^{2}	1.5
Total[f]	**4.85×10^{1}**	**100.6**	**4.60×10^{7}**	**100.2**	**1.18×10^{1}**	**0.4**	**1.21×10^{1}**	**0.1**	**9.41×10^{2}**	**100.3**	**1.41×10^{2}**	**100.2**	**8.16×10^{4}**	**100.2**	**5.06×10^{7}**	**100.1**	**3.02×10^{4}**	**101.5**
Other Inventory																		
Solid and liquid secondary waste from cesium and strontium capsules	0	N/A	1.99×10^{5}	N/A	0	N/A	0	N/A	0	N/A	0	N/A	0	N/A	3.16×10^{5}	N/A	0	N/A
Cesium and strontium capsules[g]	0	N/A	4.59×10^{7}	N/A	0	N/A	0	N/A	0	N/A	0	N/A	0	N/A	1.98×10^{7}	N/A	0	N/A
PPF glass and retired PPF melters[h]	5.43×10^{-2}	N/A	2.08×10^{5}	N/A	0	N/A	0	N/A	7.83	N/A	5.26×10^{-1}	N/A	3.53×10^{1}	N/A	6.71×10^{4}	N/A	1.39×10^{2}	N/A
Rubble, soil, and equipment[i]	3.43×10^{-1}	N/A	2.62×10^{5}	N/A	2.36×10^{1}	N/A	2.17×10^{2}	N/A	1.02×10^{1}	N/A	6.68×10^{-1}	N/A	9.92×10^{1}	N/A	1.32×10^{5}	N/A	1.78×10^{2}	N/A
Air Emissions																		
Treatment air emissions[j]	4.85×10^{1}	N/A	4.72×10^{4}	N/A	3.14×10^{3}	N/A	1.22×10^{4}	N/A	4.74×10^{-1}	N/A	NR	N/A	4.07×10^{1}	N/A	3.58×10^{4}	N/A	1.49×10^{1}	N/A

[a] Source of BBI data is *Inventory and Source Term Data Package*, DOE-ORP-2003-02, Rev. 0 (DOE 2003a).

[b] Represents 99.9 percent retrieval. For analysis purposes, waste inventories from tank waste retrieval leaks and ancillary equipment were assumed to be treated in the Waste Treatment Plant and via supplemental treatment processes.

[c] To be stored on site until disposition decisions are made and implemented. This inventory would include the retired HLW melters.

[d] Includes secondary liquids that would be sent to the ETF and treated; solids would be disposed of in an Integrated Disposal Facility. Excludes liquid secondary waste from the processing of cesium and strontium capsules, which would be reported separately.

[e] Includes solid low-level radioactive waste and mixed low-level radioactive waste streams that would be generated by waste treatment operations and the PPF. Such waste streams would include debris waste, melter consumables, failed process components, analytical laboratory waste, spent resins, spent carbon adsorbent, high-efficiency particulate air filters, and other process-related waste. Disposal would take place in an Integrated Disposal Facility. Excludes contaminated liquid effluent waste streams, which would be treated at the ETF.

[f] Totals may exceed 100 percent due to conservative estimates or rounded numbers. BBI percentages were rounded to the nearest tenth. Carbon-14 and hydrogen-3 (tritium) may not total 100 percent; a portion of each would be released to the offgas streams and stack, and a portion (ETF-generated liquid) would be disposed of in the State-Approved Land Disposal Site.

[g] To be treated in the Waste Treatment Plant, resulting in glass waste, which would be stored on site until disposition decisions are made and implemented.

[h] Derived from clean closure of all single-shell tank farms. Disposal of PPF glass and retired PPF melters would take place in an Integrated Disposal Facility.

[i] Rubble, soil, and equipment would be generated by clean closure of all single-shell tank farms. Disposal would take place in the River Protection Project Disposal Facility.

[j] Includes air emissions from all waste treatment processes, including those from treatment of the cesium and strontium capsules. For analysis purposes, both iodine-129 capture and air emission releases were assumed.

Key: %=percent; BBI=Best-Basis Inventory; ETF=Effluent Treatment Facility; HLW=high-level radioactive waste; IHLW=immobilized high-level radioactive waste; N/A=not applicable; NR=not reported; PPF=Preprocessing Facility.

Source: SAIC 2011.

Table D–54. Tank Closure Alternative 6A, Base Case, Chemical Constituents of Potential Concern Balance

	Chromium		Mercury		Nitrate		Lead		Total Uranium		Acetonitrile		Benzene		Butanol		PCBs		2,4,6-TCP	
	Kg	% of BBI	Kg	% of BBI	Kg	% of BBI	Kg	% of BBI	Kg	% of BBI	Kg	% of BBI	Kg	% of BBI	Kg	% of BBI	Kg	% of BBI	Kg	% of BBI
Best-Basis Inventory																				
BBI[a]	5.98×10^{5}	N/A	1.83×10^{3}	N/A	7.08×10^{7}	N/A	8.41×10^{4}	N/A	5.97×10^{5}	N/A	2.95×10^{4}	N/A	2.40	N/A	3.45×10^{6}	N/A	1.68×10^{3}	N/A	1.11	N/A
Tank Closure Waste Inventory																				
Tank residual waste[b]	5.98×10^{2}	0.1	1.83	0.1	7.08×10^{4}	0.1	8.41×10^{1}	0.1	5.97×10^{2}	0.1	2.95×10^{1}	0.1	2.40×10^{-3}	0.1	3.45×10^{3}	0.1	1.68	0.1	1.11×10^{-3}	0.1
IHLW glass[c]	5.96×10^{5}	99.7	0	0.0	0	0.0	8.42×10^{4}	100.1	5.95×10^{5}	99.7	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
ETF-generated solid secondary waste[d]	4.53×10^{1}	0.0	5.60	0.3	9.16×10^{6}	12.9	4.64	0.0	4.14×10^{1}	0.0	NR	N/A	NR	N/A	NR	N/A	NR	N/A	NR	N/A
Solid secondary waste[e]	1.98×10^{3}	0.3	1.78×10^{3}	97.4	0	0.0	2.50×10^{2}	0.3	2.40×10^{3}	0.4	NR	N/A	NR	N/A	NR	N/A	NR	N/A	NR	N/A
Total[f]	**5.99×10^{5}**	**100.1**	**1.78×10^{3}**	**97.8**	**9.23×10^{6}**	**13.0**	**8.45×10^{4}**	**100.5**	**5.98×10^{5}**	**100.2**	**2.95×10^{1}**	**0.1**	**2.40×10^{-3}**	**0.1**	**3.45×10^{3}**	**0.1**	**1.68**	**0.1**	**1.11×10^{-3}**	**0.1**
Other Inventory[g]																				
PPF glass and retired PPF melters[h]	8.52×10^{3}	N/A	0	N/A	0	N/A	2.72×10^{2}	N/A	1.62×10^{2}	N/A	0	N/A	0	N/A	0	N/A	0	N/A	0	N/A
Rubble, soil, and equipment[i]	4.10×10^{3}	N/A	2.40	N/A	2.83×10^{5}	N/A	3.47×10^{2}	N/A	7.66×10^{3}	N/A	1.47	N/A	1.20×10^{-4}	N/A	6.29×10^{2}	N/A	2.82×10^{-1}	N/A	5.54×10^{-5}	N/A
Air Emissions																				
Treatment air emissions[j]	NR	N/A	1.83×10^{3}	N/A	NR	N/A	NR	N/A	NR	N/A	NR	N/A	3.78×10^{3}	N/A	NR	N/A	NR	N/A	NR	N/A

a Source of BBI data is *Inventory and Source Term Data Package*, DOE-ORP-2003-02, Rev. 0 (DOE 2003a).

b Represents 99.9 percent retrieval. For analysis purposes, waste inventories from tank waste retrieval leaks and ancillary equipment were assumed to be treated in the Waste Treatment Plant and via supplemental treatment processes.

c To be stored on site until disposition decisions are made and implemented. This inventory would include the retired HLW melters.

d Includes secondary liquids that would be sent to the ETF and treated; solids would be disposed of in an Integrated Disposal Facility.

e Includes solid low-level radioactive waste and mixed low-level radioactive waste streams that would be generated by the waste treatment operations and the PPF. Such waste streams would include debris waste, melter consumables, failed process components, analytical laboratory waste, spent resins, spent carbon adsorbent, high-efficiency particulate air filters, and other process-related waste. Disposal would take place in an Integrated Disposal Facility. Excludes contaminated liquid effluent waste streams, which would be treated at the ETF.

f Totals may exceed 100 percent due to conservative estimates or rounded numbers. BBI percentages were rounded to the nearest tenth. The organic chemicals (acetonitrile, benzene, butanol, PCBs, and 2,4,6-TCP) may not total 100 percent because they would be destroyed during thermal treatment processes. Nitrate may not total 100 percent because it would be volatilized and released through the facility stack.

g No chemical constituents of potential concern have been reported in the cesium and strontium capsule secondary-waste streams.

h Derived from clean closure of all single-shell tank farms. Disposal of PPF glass and retired PPF melters would take place in an Integrated Disposal Facility.

i Rubble, soil, and equipment would be generated by clean closure of all single-shell tank farms. Disposal would take place in the River Protection Project Disposal Facility.

j Includes air emissions from all waste treatment processes, including those from treatment of the cesium and strontium capsules. For analysis purposes, both mercury capture and air emission releases were assumed.

Note: To convert kilograms to pounds, multiply by 2.2046.

Key: %=percent; BBI=Best-Basis Inventory; butanol=n-butyl alcohol; ETF=Effluent Treatment Facility; HLW=high-level radioactive waste; IHLW=immobilized high-level radioactive waste; Kg=kilograms; N/A=not applicable; NR=not reported; PCB=polychlorinated biphenyl; PPF=Preprocessing Facility; TCP=trichlorophenol.

Source: SAIC 2011.

Table D–55. Tank Closure Alternative 6A, Option Case, Radioactive Constituents of Potential Concern Balance

	Iodine-129		Cesium-137		Carbon-14		Hydrogen-3 (Tritium)		Uranium-233, -234, -235, -238		Neptunium-237		Plutonium -239, -240		Strontium-90		Technetium-99	
	Curies	% of BBI	Curies	% of BBI	Curies	% of BBI	Curies	% of BBI	Curies	% of BBI	Curies	% of BBI	Curies	% of BBI	Curies	% of BBI	Curies	% of BBI
Best-Basis Inventory																		
BBI[a]	4.82×10^{1}	N/A	4.58×10^{7}	N/A	3.12×10^{3}	N/A	1.21×10^{4}	N/A	9.38×10^{2}	N/A	1.41×10^{2}	N/A	8.14×10^{4}	N/A	5.05×10^{7}	N/A	2.97×10^{4}	N/A
Tank Closure Waste Inventory																		
Tank residual waste[b]	4.82×10^{-2}	0.1	4.58×10^{4}	0.1	3.12	0.1	1.21×10^{1}	0.1	9.38×10^{-1}	0.1	1.41×10^{-1}	0.1	8.14×10^{1}	0.1	5.05×10^{4}	0.1	2.97×10^{1}	0.1
IHLW glass[c]	9.64	20.0	4.57×10^{7}	99.7	0	0.0	0	0.0	9.36×10^{2}	99.8	1.41×10^{2}	99.9	8.14×10^{4}	99.9	4.98×10^{7}	98.5	2.96×10^{4}	99.6
ETF-generated solid secondary waste[d]	3.43×10^{1}	71.2	4.65×10^{-1}	0.0	8.69	0.3	0	0.0	4.16×10^{-2}	0.0	5.26×10^{-2}	0.0	7.04×10^{-4}	0.0	6.49	0.0	8.80×10^{1}	0.3
Solid secondary waste[e]	4.75	9.9	1.98×10^{5}	0.4	0	0.0	0	0.0	3.74	0.4	2.90×10^{-1}	0.2	2.03×10^{2}	0.2	7.84×10^{5}	1.6	4.40×10^{2}	1.5
Total[f]	**4.88×10^{1}**	**101.2**	**4.60×10^{7}**	**100.2**	**1.18×10^{1}**	**0.4**	**1.21×10^{1}**	**0.1**	**9.41×10^{2}**	**100.3**	**1.41×10^{2}**	**100.2**	**8.16×10^{4}**	**100.2**	**5.06×10^{7}**	**100.1**	**3.02×10^{4}**	**101.5**
Other Inventory																		
Solid and liquid secondary waste from cesium and strontium capsules	0	N/A	1.99×10^{5}	N/A	0	N/A	0	N/A	0	N/A	0	N/A	0	N/A	3.16×10^{5}	N/A	0	N/A
Cesium and strontium capsules[g]	0	N/A	4.59×10^{7}	N/A	0	N/A	0	N/A	0	N/A	0	N/A	0	N/A	1.98×10^{7}	N/A	0	N/A
PPF glass and retired PPF melters[h]	1.23×10^{-1}	N/A	2.20×10^{5}	N/A	0	N/A	0	N/A	1.69×10^{1}	N/A	2.67	N/A	9.39×10^{2}	N/A	7.84×10^{4}	N/A	3.44×10^{2}	N/A
Rubble, soil, and equipment[i]	4.96×10^{-1}	N/A	2.72×10^{5}	N/A	3.35×10^{1}	N/A	3.79×10^{3}	N/A	1.42×10^{1}	N/A	1.6	N/A	4.85×10^{2}	N/A	1.39×10^{5}	N/A	2.70×10^{2}	N/A
Air Emissions																		
Treatment air emissions[j]	4.86×10^{1}	N/A	4.72×10^{4}	N/A	3.15×10^{3}	N/A	1.50×10^{4}	N/A	4.76×10^{-1}	N/A	NR	N/A	4.09×10^{1}	N/A	3.58×10^{4}	N/A	1.50×10^{1}	N/A

[a] Source of BBI data is *Inventory and Source Term Data Package*, DOE-ORP-2003-02, Rev. 0 (DOE 2003a).

[b] Represents 99.9 percent retrieval. For analysis purposes, waste inventories from tank waste retrieval leaks and ancillary equipment were assumed to be treated in the Waste Treatment Plant.

[c] To be stored on site until disposition decisions are made and implemented. This inventory would include the retired HLW melters.

[d] Includes secondary liquids that would be sent to the ETF and treated; solids would be disposed of in an Integrated Disposal Facility. Excludes liquid secondary waste from the processing of cesium and strontium capsules, which would be reported separately.

[e] Includes solid low-level radioactive waste and mixed low-level radioactive waste streams that would be generated by waste treatment operations and the PPF. Such waste streams would include debris waste, melter consumables, failed process components, analytical laboratory waste, spent resins, spent carbon adsorbent, high-efficiency particulate air filters, and other process-related waste. Disposal would take place in an Integrated Disposal Facility. Excludes contaminated liquid effluent waste streams, which would be treated at the ETF.

[f] Totals may exceed 100 percent due to conservative estimates or rounded numbers. BBI percentages were rounded to the nearest tenth. Carbon-14 and hydrogen-3 (tritium) may not total 100 percent because a portion of each would be released to the offgas streams and stack, and a portion (ETF-generated liquid) would be disposed of in the State-Approved Land Disposal Site.

[g] To be treated in the Waste Treatment Plant, resulting in glass waste, which would be stored on site until disposition decisions are made and implemented.

[h] Derived from clean closure of all single-shell tank farms and six sets of contiguous cribs and trenches (ditches). Disposal of PPF glass and retired PPF melters would take place in an Integrated Disposal Facility.

[i] Rubble, soil, and equipment would be generated by clean closure of all single-shell tank farms. Disposal would take place in the River Protection Project Disposal Facility.

[j] Includes air emissions from all waste treatment processes, including those from treatment of the cesium and strontium capsules. For analysis purposes, both iodine-129 capture and air emission releases were assumed.

Key: %=percent; BBI=Best-Basis Inventory; ETF=Effluent Treatment Facility; HLW=high-level radioactive waste; IHLW=immobilized high-level radioactive waste; N/A=not applicable; NR=not reported; PPF=Preprocessing Facility.

Source: SAIC 2011.

Table D–56. Tank Closure Alternative 6A, Option Case, Chemical Constituents of Potential Concern Balance

	Chromium		Mercury		Nitrate		Lead		Total Uranium		Acetonitrile		Benzene		Butanol		PCBs		2,4,6-TCP	
	Kg	% of BBI	Kg	% of BBI	Kg	% of BBI	Kg	% of BBI	Kg	% of BBI	Kg	% of BBI	Kg	% of BBI	Kg	% of BBI	Kg	% of BBI	Kg	% of BBI
Best-Basis Inventory																				
BBI[a]	5.98×10^{5}	N/A	1.83×10^{3}	N/A	7.08×10^{7}	N/A	8.41×10^{4}	N/A	5.97×10^{5}	N/A	2.95×10^{4}	N/A	2.40	N/A	3.45×10^{6}	N/A	1.68×10^{3}	N/A	1.11	N/A
Tank Closure Waste Inventory																				
Tank residual waste[b]	5.98×10^{2}	0.1	1.83	0.1	7.08×10^{4}	0.1	8.41×10^{1}	0.1	5.97×10^{2}	0.1	2.95×10^{1}	0.1	2.40×10^{-3}	0.1	3.45×10^{3}	0.1	1.68	0.1	1.11×10^{-3}	0.1
IHLW glass[c]	5.96×10^{5}	99.7	0	0.0	0	0.0	8.42×10^{4}	100.1	5.95×10^{5}	99.7	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
ETF-generated solid secondary waste[d]	5.65×10^{1}	0.0	5.79	0.3	1.51×10^{7}	21.3	4.64	0.0	4.19×10^{1}	0.0	NR	N/A	NR	N/A	NR	N/A	NR	N/A	NR	N/A
Solid secondary waste[e]	2.47×10^{3}	0.4	1.84×10^{3}	100.6	0	0.0	2.50×10^{2}	0.3	2.43×10^{3}	0.4	NR	N/A	NR	N/A	NR	N/A	NR	N/A	NR	N/A
Total[f]	**5.99×10^{5}**	**100.2**	**1.84×10^{3}**	**101.1**	**1.51×10^{7}**	**21.4**	**8.45×10^{4}**	**100.5**	**5.98×10^{5}**	**100.2**	**2.95×10^{1}**	**0.1**	**2.40×10^{-3}**	**0.1**	**3.45×10^{3}**	**0.1**	**1.68**	**0.1**	**1.11×10^{-3}**	**0.1**
Other Inventory[g]																				
PPF glass and retired PPF melters[h]	1.60×10^{5}	N/A	0	N/A	0	N/A	3.11×10^{2}	N/A	2.28×10^{4}	N/A	0	N/A	0	N/A	0	N/A	0	N/A	0	N/A
Rubble, soil, and equipment[i]	3.69×10^{4}	N/A	1.59×10^{1}	N/A	1.04×10^{7}	N/A	3.58×10^{2}	N/A	9.24×10^{3}	N/A	1.47	N/A	1.20×10^{-4}	N/A	6.29×10^{2}	N/A	2.82×10^{-1}	N/A	5.54×10^{-5}	N/A
Air Emissions																				
Treatment air emissions[j]	NR	N/A	1.83×10^{3}	N/A	NR	N/A	NR	N/A	NR	N/A	NR	N/A	3.78×10^{3}	N/A	NR	N/A	NR	N/A	NR	N/A

a Source of BBI data is *Inventory and Source Term Data Package*, DOE-ORP-2003-02, Rev. 0 (DOE 2003a).

b Represents 99.9 percent retrieval. For analysis purposes, waste inventories from tank waste retrieval leaks and ancillary equipment were assumed to be treated in the Waste Treatment Plant.

c To be stored on site until disposition decisions are made and implemented. This inventory would include the retired HLW melters.

d Includes secondary liquids that would be sent to the ETF and treated; solids would be disposed of in an Integrated Disposal Facility.

e Includes solid low-level radioactive waste and mixed low-level radioactive waste streams that would be generated by the waste treatment operations and the PPF. Such waste streams would include debris waste, melter consumables, failed process components, analytical laboratory waste, spent resins, spent carbon adsorbent, high-efficiency particulate air filters, and other process-related waste. Disposal would take place in an Integrated Disposal Facility. Excludes contaminated liquid effluent waste streams, which would be treated at the ETF.

f Totals may exceed 100 percent due to conservative estimates or rounded numbers. BBI percentages were rounded to the nearest tenth. The organic chemicals (acetonitrile, benzene, butanol, PCBs, and 2,4,6-TCP) may not total 100 percent because they would be destroyed during thermal treatment processes. Nitrate may not total 100 percent because it would be volatilized and released through the facility stack.

g No chemical constituents of potential concern have been reported in the cesium and strontium capsule secondary-waste streams.

h Derived from clean closure of all single-shell tank farms and the six sets of contiguous cribs and trenches (ditches). Disposal of PPF glass and retired PPF melters would take place in an Integrated Disposal Facility.

i Rubble, soil, and equipment would be generated by clean closure of all single-shell tank farms. Disposal would take place in the River Protection Project Disposal Facility.

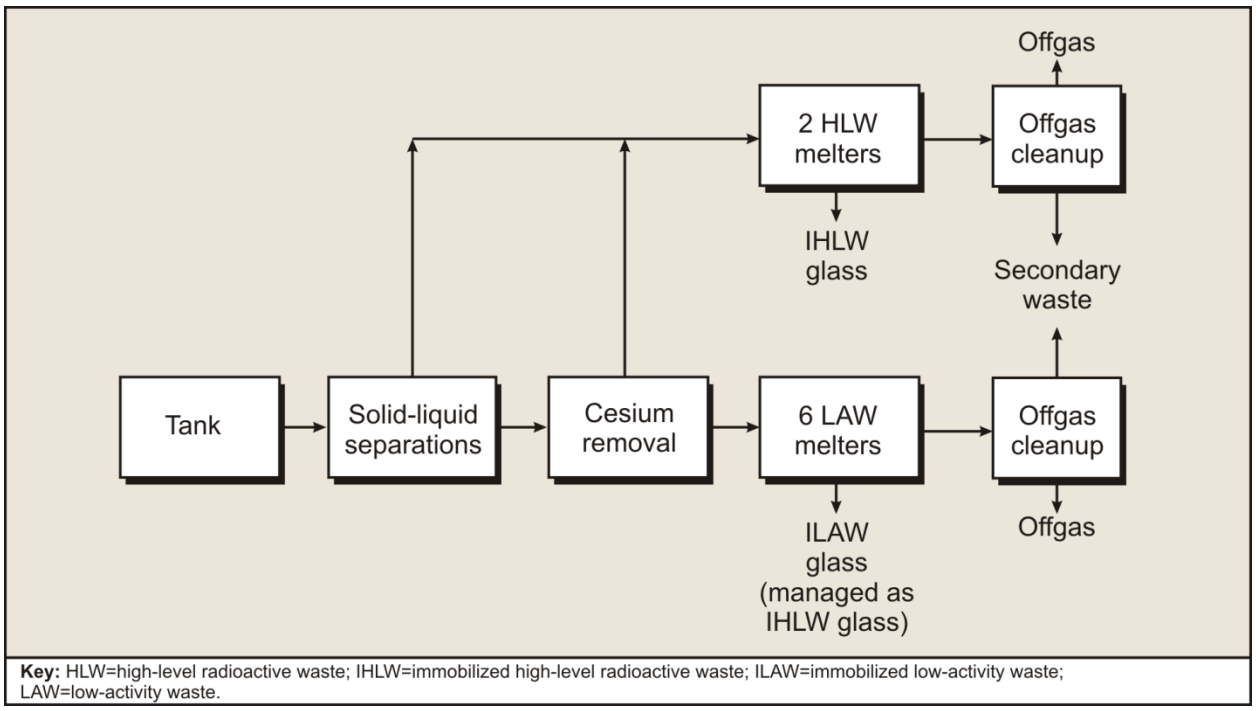
j Includes air emissions from all waste treatment processes, including those from treatment of the cesium and strontium capsules. Disposal would take place in the River Protection Project Disposal Facility. For analysis purposes, both mercury capture and air emission releases were assumed.

Note: To convert kilograms to pounds, multiply by 2.2046.

Key: %=percent; BBI=Best-Basis Inventory; butanol=n-butyl alcohol; ETF=Effluent Treatment Facility; HLW=high-level radioactive waste; IHLW=immobilized high-level radioactive waste; Kg=kilograms; N/A=not applicable; NR=not reported; PCB=polychlorinated biphenyl; PPF=Preprocessing Facility; TCP=trichlorophenol.

Source: SAIC 2011.

Under Tank Closure Alternative 6B, Base Case, represented in Figure D–11, all waste streams, including those resulting from clean closure of the SSTs, would be managed as IHLW glass. Under Tank Closure Alternative 6B, Option Case, the six sets of contiguous cribs and trenches (ditches) described in Section D.1.5 would be added to the Alternative 6B, Base Case, inventory. Material balance summaries for these two cases are presented in Tables D–57 through D–60. However, under Tank Closure Alternative 6B, the tank waste would be treated in a shorter period of time than under Tank Closure Alternative 6A due to the use of LAW melters. The ILAW glass would be managed as IHLW glass.



Key: HLW=high-level radioactive waste; IHLW=immobilized high-level radioactive waste; ILAW=immobilized low-activity waste; LAW=low-activity waste.

Figure D–11. Tank Closure Alternatives 6B and 6C Flowsheet

Table D–57. Tank Closure Alternative 6B, Base Case, Radioactive Constituents of Potential Concern Balance

	Iodine-129		Cesium-137		Carbon-14		Hydrogen-3 (Tritium)		Uranium-233, -234, -235, -238		Neptunium-237		Plutonium -239, -240		Strontium-90		Technetium-99	
	Curies	% of BBI	Curies	% of BBI	Curies	% of BBI	Curies	% of BBI	Curies	% of BBI	Curies	% of BBI	Curies	% of BBI	Curies	% of BBI	Curies	% of BBI
Best-Basis Inventory																		
BBI[a]	4.82×10^{1}	N/A	4.58×10^{7}	N/A	3.12×10^{3}	N/A	1.21×10^{4}	N/A	9.38×10^{2}	N/A	1.41×10^{2}	N/A	8.14×10^{4}	N/A	5.05×10^{7}	N/A	2.97×10^{4}	N/A
Tank Closure Waste Inventory																		
Tank residual waste[b]	4.82×10^{-2}	0.1	4.58×10^{4}	0.1	3.12	0.1	1.21×10^{1}	0.1	9.38×10^{-1}	0.1	1.41×10^{-1}	0.1	8.14×10^{1}	0.1	5.05×10^{4}	0.1	2.97×10^{1}	0.1
IHLW glass[c]	7.05×10^{-3}	0.0	4.53×10^{7}	98.7	0	0.0	0	0.0	8.81×10^{2}	93.9	1.41×10^{2}	99.9	8.14×10^{4}	99.9	4.97×10^{7}	98.5	2.49×10^{2}	0.8
ILAW glass and retired LAW melters[d]	9.65	20.0	4.49×10^{5}	1.0	0	0.0	0	0.0	5.52×10^{1}	5.9	8.43×10^{-3}	0.0	1.47	0.0	2.33×10^{3}	0.0	2.91×10^{4}	97.8
ETF-generated solid secondary waste[e]	3.41×10^{1}	70.7	4.65×10^{-1}	0.0	8.63	0.3	0	0.0	4.11×10^{-2}	0.0	5.18×10^{-2}	0.0	6.96×10^{-4}	0.0	6.49	0.0	8.74×10^{1}	0.3
Solid secondary waste[f]	4.72	9.8	1.98×10^{5}	0.4	0	0.0	0	0.0	3.70	0.4	2.86×10^{-1}	0.2	2.00×10^{2}	0.2	7.84×10^{5}	1.6	4.37×10^{2}	1.5
Total[g]	**4.85×10^{1}**	**100.6**	**4.60×10^{7}**	**100.3**	**1.18×10^{1}**	**0.4**	**1.21×10^{1}**	**0.1**	**9.41×10^{2}**	**100.3**	**1.41×10^{2}**	**100.2**	**8.16×10^{4}**	**100.2**	**5.06×10^{7}**	**100.1**	**2.99×10^{4}**	**100.5**
Other Inventory																		
Solid and liquid secondary waste from cesium and strontium capsules	0	N/A	1.99×10^{5}	N/A	0	N/A	0	N/A	0	N/A	0	N/A	0	N/A	3.16×10^{5}	N/A	0	N/A
Cesium and strontium capsules[h]	0	N/A	4.59×10^{7}	N/A	0	N/A	0	N/A	0	N/A	0	N/A	0	N/A	1.98×10^{7}	N/A	0	N/A
PPF glass and retired PPF melters[i]	5.31×10^{-2}	N/A	2.03×10^{5}	N/A	0	N/A	0	N/A	7.66	N/A	5.14×10^{-1}	N/A	3.45×10^{1}	N/A	6.57×10^{4}	N/A	1.35×10^{2}	N/A
Rubble, soil, and equipment[j]	3.43×10^{-1}	N/A	2.62×10^{5}	N/A	2.36×10^{1}	N/A	2.17×10^{2}	N/A	1.02×10^{1}	N/A	6.68×10^{-1}	N/A	9.92×10^{1}	N/A	1.32×10^{5}	N/A	1.78×10^{2}	N/A
Air Emissions																		
Treatment air emissions[k]	4.81×10^{1}	N/A	4.71×10^{4}	N/A	3.12×10^{3}	N/A	1.21×10^{4}	N/A	4.71×10^{-1}	N/A	NR	N/A	4.04×10^{1}	N/A	3.56×10^{4}	N/A	1.48×10^{1}	N/A

[a] Source of BBI data is *Inventory and Source Term Data Package*, DOE-ORP-2003-02, Rev. 0 (DOE 2003a).

[b] Represents 99.9 percent retrieval. For analysis purposes, waste inventories from tank waste retrieval leaks and ancillary equipment were assumed to be treated in the Waste Treatment Plant.

[c] To be stored on site until disposition decisions are made and implemented. This inventory would include the retired HLW melters.

[d] Although processed as ILAW glass, glass and retired melters would be managed and disposed of as IHLW glass.

[e] Includes secondary liquids that would be sent to the ETF and treated; solids would be disposed of in an Integrated Disposal Facility. Excludes liquid secondary waste from the processing of cesium and strontium capsules, which would be reported separately.

[f] Includes solid low-level radioactive waste and mixed low-level radioactive waste streams that would be generated by the waste treatment operations and the PPF. Such waste streams would include debris waste, melter consumables, failed process components, analytical laboratory waste, spent resins, spent carbon adsorbent, high-efficiency particulate air filters, and other process-related waste. Disposal would take place in an Integrated Disposal Facility. Excludes contaminated liquid effluent waste streams, which would be treated at the ETF.

[g] Totals may exceed 100 percent due to conservative estimates or rounded numbers. BBI percentages were rounded to the nearest tenth. Carbon-14 and hydrogen-3 (tritium) may not total 100 percent because a portion of each would be released to the offgas streams and stack, and a portion (ETF-generated liquid) would be disposed of in the State-Approved Land Disposal Site.

[h] To be treated in the Waste Treatment Plant, resulting in glass waste, which would be stored on site until disposition decisions are made and implemented.

[i] Derived from clean closure of all single-shell tank farms. Disposal of PPF glass and retired PPF melters would take place in an Integrated Disposal Facility.

[j] Rubble, soil, and equipment would be generated by clean closure of all single-shell tank farms and six sets of contiguous cribs and trenches (ditches). Disposal would take place in the River Protection Project Disposal Facility.

[k] Includes the air emissions from all waste treatment processes, including those from treatment of the cesium and strontium capsules. For analysis purposes, both iodine-129 capture and air emission releases were assumed.

Key: %=percent; BBI=Best-Basis Inventory; ETF=Effluent Treatment Facility; HLW=high-level radioactive waste; IHLW=immobilized high-level radioactive waste; ILAW=immobilized low-activity waste; LAW=low-activity waste; N/A=not applicable; NR=not reported; PPF=Preprocessing Facility.

Source: SAIC 2011.

Table D–58. Tank Closure Alternative 6B, Base Case, Chemical Constituents of Potential Concern Balance

	Chromium		Mercury		Nitrate		Lead		Total Uranium		Acetonitrile		Benzene		Butanol		PCBs		2,4,6-TCP	
	Kg	% of BBI	Kg	% of BBI	Kg	% of BBI	Kg	% of BBI	Kg	% of BBI	Kg	% of BBI	Kg	% of BBI	Kg	% of BBI	Kg	% of BBI	Kg	% of BBI
Best-Basis Inventory																				
BBI[a]	5.98×10^{5}	N/A	1.83×10^{3}	N/A	7.08×10^{7}	N/A	8.41×10^{4}	N/A	5.97×10^{5}	N/A	2.95×10^{4}	N/A	2.40	N/A	3.45×10^{6}	N/A	1.68×10^{3}	N/A	1.11	N/A
Tank Closure Waste Inventory																				
Tank residual waste[b]	5.98×10^{2}	0.1	1.83	0.1	7.08×10^{4}	0.1	8.41×10^{1}	0.1	5.97×10^{2}	0.1	2.95×10^{1}	0.1	2.40×10^{-3}	0.1	3.45×10^{3}	0.1	1.68	0.1	1.11×10^{-3}	0.1
IHLW glass[c]	1.37×10^{5}	22.9	0	0.0	0	0.0	7.52×10^{4}	89.4	5.57×10^{5}	93.4	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
ILAW glass and retired LAW melters[d]	4.60×10^{5}	76.9	0	0.0	0	0.0	8.96×10^{3}	10.7	3.78×10^{4}	6.3	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
ETF-generated solid secondary waste[e]	4.53×10^{1}	0.0	5.60	0.3	9.16×10^{6}	12.9	4.64	0.0	4.14×10^{1}	0.0	NR	N/A	NR	N/A	NR	N/A	NR	N/A	NR	N/A
Solid secondary waste[f]	1.98×10^{3}	0.3	1.78×10^{3}	97.4	0	0.0	2.50×10^{2}	0.3	2.40×10^{3}	0.4	NR	N/A	NR	N/A	NR	N/A	NR	N/A	NR	N/A
Total[g]	**6.00×10^{5}**	**100.3**	**1.78×10^{3}**	**97.8**	**9.23×10^{6}**	**13.0**	**8.45×10^{4}**	**100.5**	**5.98×10^{5}**	**100.2**	**2.95×10^{1}**	**0.1**	**2.40×10^{-3}**	**0.1**	**3.45×10^{3}**	**0.1**	**1.68**	**0.1**	**1.11×10^{-3}**	**0.1**
Other Inventory[h]																				
PPF glass and retired PPF melters[i]	8.33×10^{3}	N/A	0	N/A	0	N/A	2.66×10^{2}	N/A	1.59×10^{4}	N/A	0	N/A	0	N/A	0	N/A	0	N/A	0	N/A
Rubble, soil, and equipment[j]	4.10×10^{3}	N/A	2.40	N/A	2.83×10^{5}	N/A	3.47×10^{2}	N/A	7.66×10^{3}	N/A	1.47	N/A	1.20×10^{-4}	N/A	6.29×10^{2}	N/A	2.82×10^{-1}	N/A	5.54×10^{-5}	N/A
Air Emissions																				
Treatment air emissions[k]	NR	N/A	1.82×10^{3}	N/A	NR	N/A	NR	N/A	NR	N/A	NR	N/A	6.15×10^{2}	N/A	NR	N/A	NR	N/A	NR	N/A

a Source of BBI data is *Inventory and Source Term Data Package*, DOE-ORP-2003-02, Rev. 0 (DOE 2003a).
b Represents 99.9 percent retrieval. For analysis purposes, waste inventories from tank waste retrieval leaks and ancillary equipment were assumed to be treated in the Waste Treatment Plant.
c To be stored on site until disposition decisions are made and implemented. This inventory would include the retired HLW melters.
d Although processed as ILAW glass, glass and retired melters would be managed and disposed of as IHLW glass.
e Includes secondary liquids that would be sent to the ETF and treated; solids would be disposed of in an Integrated Disposal Facility.
f Includes solid low-level radioactive waste and mixed low-level radioactive waste streams that would be generated by the waste treatment operations and the PPF. Such waste streams would include debris waste, melter consumables, failed process components, analytical laboratory waste, spent resins, spent carbon adsorbent, high-efficiency particulate air filters, and other process-related waste. Disposal would take place in an Integrated Disposal Facility. Excludes contaminated liquid effluent waste streams, which would be treated at the ETF.
g Totals may exceed 100 percent due to conservative estimates or rounded numbers. BBI percentages were rounded to the nearest tenth. The organic chemicals (acetonitrile, benzene, butanol, PCBs, and 2,4,6-TCP) may not total 100 percent because they would be destroyed during thermal treatment processes. Nitrate may not total 100 percent because it would be volatilized and released through the facility stack.
h No chemical constituents of potential concern have been reported in the cesium and strontium capsule secondary-waste streams.
i Derived from clean closure of all single-shell tank farms. Disposal of PPF glass and retired PPF melters would take place in an Integrated Disposal Facility.
j Rubble, soil, and equipment would be generated by clean closure of all single-shell tank farms and six sets of contiguous cribs and trenches (ditches). Disposal would take place in the River Protection Project Disposal Facility.
k Includes air emissions from all waste treatment processes, including those from treatment of the cesium and strontium capsules. For analysis purposes, both mercury capture and air emission releases were assumed.

Note: To convert kilograms to pounds, multiply by 2.2046
Key: %=percent; BBI=Best-Basis Inventory; butanol=n-butyl alcohol; ETF=Effluent Treatment Facility; HLW=high-level radioactive waste; IHLW=immobilized high-level radioactive waste; ILAW=immobilized low-activity waste; Kg=kilograms; LAW=low-activity waste; N/A=not applicable; NR=not reported; PCB=polychlorinated biphenyl; PPF=Preprocessing Facility; TCP=trichlorophenol.
Source: SAIC 2011.

Table D–59. Tank Closure Alternative 6B, Option Case, Radioactive Constituents of Potential Concern Balance

	Iodine-129		Cesium-137		Carbon-14		Hydrogen-3 (Tritium)		Uranium-233, -234, -235, -238		Neptunium-237		Plutonium -239, -240		Strontium-90		Technetium-99	
	Curies	% of BBI	Curies	% of BBI	Curies	% of BBI	Curies	% of BBI	Curies	% of BBI	Curies	% of BBI	Curies	% of BBI	Curies	% of BBI	Curies	% of BBI
Best-Basis Inventory																		
BBI[a]	4.82×10^{1}	N/A	4.58×10^{7}	N/A	3.12×10^{3}	N/A	1.21×10^{4}	N/A	9.38×10^{2}	N/A	1.41×10^{2}	N/A	8.14×10^{4}	N/A	5.05×10^{7}	N/A	2.97×10^{4}	N/A
Tank Closure Waste Inventory																		
Tank residual waste[b]	4.82×10^{-2}	0.1	4.58×10^{4}	0.1	3.12	0.1	1.21×10^{1}	0.1	9.38×10^{-1}	0.1	1.41×10^{-1}	0.1	8.14×10^{1}	0.1	5.05×10^{4}	0.1	2.97×10^{1}	0.1
IHLW glass[c]	7.05×10^{-3}	0.0	4.53×10^{7}	98.7	0	0.0	0	0.0	8.81×10^{2}	93.9	1.41×10^{2}	99.9	8.14×10^{4}	99.9	4.97×10^{7}	98.5	2.49×10^{2}	0.8
ILAW glass and retired LAW melters[d]	9.65	20.0	4.49×10^{5}	1.0	0	0.0	0	0.0	5.52×10^{1}	5.9	8.43×10^{-3}	0.0	1.47	0.0	2.33×10^{3}	0.0	2.91×10^{4}	97.8
ETF-generated solid secondary waste[e]	3.43×10^{1}	71.2	4.65×10^{-1}	0.0	8.69	0.3	0	0.0	4.16×10^{-2}	0.0	5.26×10^{-2}	0.0	7.04×10^{-4}	0.0	6.49	0.0	8.80×10^{1}	0.3
Solid secondary waste[f]	4.75	9.9	1.98×10^{5}	0.4	0	0.0	0	0.0	3.74	0.4	2.90×10^{-1}	0.2	2.03×10^{2}	0.2	7.84×10^{5}	1.6	4.40×10^{2}	1.5
Total[g]	**4.88×10^{1}**	**101.2**	**4.60×10^{7}**	**100.3**	**1.18×10^{1}**	**0.4**	**1.21×10^{1}**	**0.1**	**9.41×10^{2}**	**100.3**	**1.41×10^{2}**	**100.2**	**8.16×10^{4}**	**100.2**	**5.06×10^{7}**	**100.1**	**2.99×10^{4}**	**100.5**
Other Inventory																		
Solid and liquid secondary waste from cesium and strontium capsules	0	N/A	1.99×10^{5}	N/A	0	N/A	0	N/A	0	N/A	0	N/A	0	N/A	3.16×10^{5}	N/A	0	N/A
Cesium and strontium capsules[h]	0	N/A	4.59×10^{7}	N/A	0	N/A	0	N/A	0	N/A	0	N/A	0	N/A	1.98×10^{7}	N/A	0	N/A
PPF glass and retired PPF melters[i]	1.23×10^{-1}	N/A	2.19×10^{5}	N/A	0	N/A	0	N/A	1.68×10^{1}	N/A	2.66	N/A	9.34×10^{2}	N/A	7.80×10^{4}	N/A	3.42×10^{2}	N/A
Rubble, soil, and equipment[j]	4.96×10^{-1}	N/A	2.72×10^{5}	N/A	3.35×10^{1}	N/A	3.79×10^{3}	N/A	1.42×10^{1}	N/A	1.60×10^{1}	N/A	4.85×10^{2}	N/A	1.39×10^{5}	N/A	2.70×10^{2}	N/A
Air Emissions																		
Treatment air emissions[k]	4.82×10^{1}	N/A	4.71×10^{4}	N/A	3.13×10^{3}	N/A	1.49×10^{4}	N/A	4.72×10^{-1}	N/A	NR	N/A	4.06×10^{1}	N/A	3.56×10^{4}	N/A	1.48×10^{1}	N/A

a Source of BBI data is *Inventory and Source Term Data Package*, DOE-ORP-2003-02, Rev. 0 (DOE 2003a).
b Represents 99.9 percent retrieval. For analysis purposes, waste inventories from tank waste retrieval leaks and ancillary equipment were assumed to be treated in the Waste Treatment Plant.
c To be stored on site until disposition decisions are made and implemented. This inventory would include the retired HLW melters.
d Although processed as ILAW glass, glass and retired melters would be managed and disposed of as IHLW glass.
e Includes secondary liquids that would be sent to the ETF and treated; solids would be disposed of in an Integrated Disposal Facility. Excludes liquid secondary waste from the processing of cesium and strontium capsules, which would be reported separately.
f Includes solid low-level radioactive waste and mixed low-level radioactive waste streams that would be generated by the waste treatment operations and the PPF. Such waste streams would include debris waste, melter consumables, failed process components, analytical laboratory waste, spent resins, spent carbon adsorbent, high-efficiency particulate air filters, and other process-related waste. Disposal would take place in an Integrated Disposal Facility. Excludes contaminated liquid effluent waste streams, which would be treated at the ETF.
g Totals may exceed 100 percent due to conservative estimates or rounded numbers. BBI percentages were rounded to the nearest tenth. Carbon-14 and hydrogen-3 (tritium) may not total 100 percent because a portion of each would be released to the offgas streams and stack, and a portion (ETF-generated liquid) would be disposed of in the State-Approved Land Disposal Site.
h To be treated in the Waste Treatment Plant, resulting in glass waste, which would be stored on site until disposition decisions are made and implemented.
i Derived from clean closure of all single-shell tank farms and the six sets of contiguous cribs and trenches (ditches). Disposal of PPF glass and retired PPF melters would take place in an Integrated Disposal Facility.
j Rubble, soil, and equipment would be generated by clean closure of all single-shell tank farms and six sets of contiguous cribs and trenches (ditches). Disposal would take place in the River Protection Project Disposal Facility.
k Includes the air emissions from all waste treatment processes, including those from treatment of the cesium and strontium capsules. For analysis purposes, both iodine-129 capture and air emission releases were assumed.

Key: %=percent; BBI=Best-Basis Inventory; ETF=Effluent Treatment Facility; HLW=high-level radioactive waste; IHLW=immobilized high-level radioactive waste; ILAW=immobilized low-activity waste; LAW=low-activity waste; N/A=not applicable; NR=not reported; PPF=Preprocessing Facility.
Source: SAIC 2011.

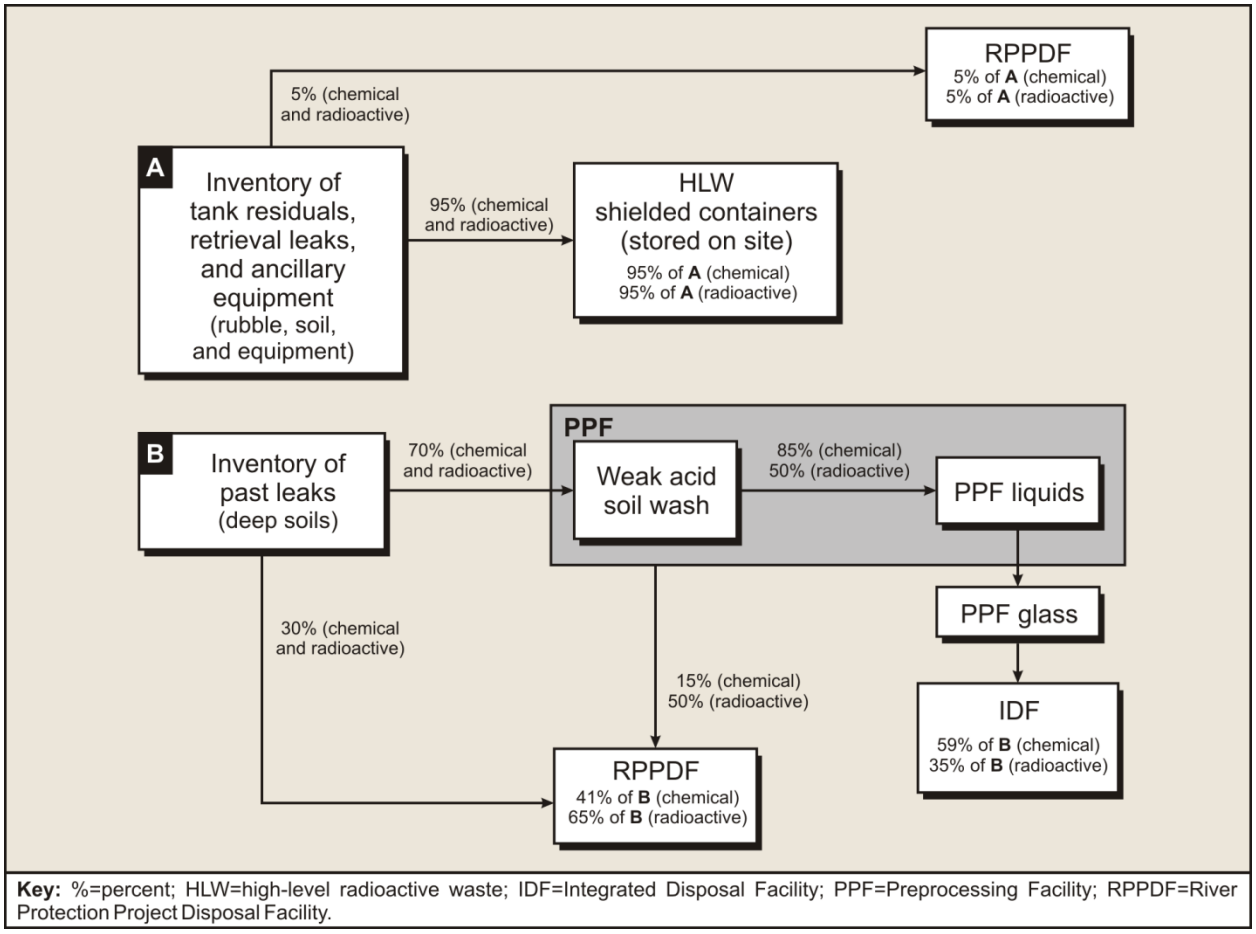
Table D–60. Tank Closure Alternative 6B, Option Case, Chemical Constituents of Potential Concern Balance

	Chromium		Mercury		Nitrate		Lead		Total Uranium		Acetonitrile		Benzene		Butanol		PCBs		2,4,6-TCP	
	Kg	% of BBI	Kg	% of BBI	Kg	% of BBI	Kg	% of BBI	Kg	% of BBI	Kg	% of BBI	Kg	% of BBI	Kg	% of BBI	Kg	% of BBI	Kg	% of BBI
Best-Basis Inventory																				
BBI[a]	5.98×10^{5}	N/A	1.83×10^{3}	N/A	7.08×10^{7}	N/A	8.41×10^{4}	N/A	5.97×10^{5}	N/A	2.95×10^{4}	N/A	2.40	N/A	3.45×10^{6}	N/A	1.68×10^{3}	N/A	1.11	N/A
Tank Closure Waste Inventory																				
Tank residual waste[b]	5.98×10^{2}	0.1	1.83	0.1	7.08×10^{4}	0.1	8.41×10^{1}	0.1	5.97×10^{2}	0.1	2.95×10^{1}	0.1	2.40×10^{-3}	0.1	3.45×10^{3}	0.1	1.68	0.1	1.11×10^{-3}	0.1
IHLW glass[c]	1.37×10^{5}	22.9	0	0.0	0	0.0	7.52×10^{4}	89.4	5.57×10^{5}	93.4	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
ILAW glass and retired LAW melters[d]	4.60×10^{5}	76.9	0	0.0	0	0.0	8.69×10^{3}	10.7	3.78×10^{4}	6.3	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
ETF-generated solid secondary waste[e]	5.65×10^{1}	0.0	5.79	0.3	1.51×10^{7}	21.3	4.64	0.0	4.19×10^{1}	0.0	NR	N/A	NR	N/A	NR	N/A	NR	N/A	NR	N/A
Solid secondary waste[f]	2.47×10^{3}	0.4	1.84×10^{3}	100.6	0	0.0	2.50×10^{2}	0.3	2.43×10^{3}	0.4	NR	N/A	NR	N/A	NR	N/A	NR	N/A	NR	N/A
Total[g]	**6.01×10^{5}**	**100.4**	**1.84×10^{3}**	**101.1**	**1.51×10^{7}**	**21.4**	**8.45×10^{4}**	**100.5**	**5.98×10^{5}**	**100.2**	**2.95×10^{1}**	**0.1**	**2.40×10^{-3}**	**0.1**	**3.45×10^{3}**	**0.1**	**1.68**	**0.1**	**1.11×10^{-3}**	**0.1**
Other Inventory[h]																				
PPF glass and retired PPF melters[i]	1.58×10^{5}	N/A	0	N/A	0	N/A	3.09×10^{2}	N/A	2.26×10^{4}	N/A	0	N/A	0	N/A	0	N/A	0	N/A	0	N/A
Rubble, soil, and equipment[j]	3.69×10^{4}	N/A	1.59×10^{1}	N/A	1.04×10^{7}	N/A	3.58×10^{2}	N/A	9.24×10^{3}	N/A	1.47	N/A	1.20×10^{-4}	N/A	6.29×10^{2}	N/A	2.82×10^{-1}	N/A	5.54×10^{-5}	N/A
Air Emissions																				
Treatment air emissions[k]	NR	N/A	1.81×10^{3}	N/A	NR	N/A	NR	N/A	NR	N/A	NR	N/A	6.17×10^{2}	N/A	NR	N/A	NR	N/A	NR	N/A

[a] Source of BBI data is *Inventory and Source Term Data Package*, DOE-ORP-2003-02, Rev. 0 (DOE 2003a).
[b] Represents 99.9 percent retrieval. For analysis purposes, waste inventories from tank waste retrieval leaks and ancillary equipment were assumed to be treated in the Waste Treatment Plant.
[c] To be stored on site until disposition decisions are made and implemented. This inventory would include the retired HLW melters.
[d] Although processed as ILAW glass, glass and retired melters would be managed and disposed of as IHLW glass.
[e] Includes secondary liquids that would be sent to the ETF and treated; solids would be disposed of in an Integrated Disposal Facility.
[f] Includes solid low-level radioactive waste and mixed low-level radioactive waste streams that would be generated by the waste treatment operations and the PPF. Such waste streams would include debris waste, melter consumables, failed process components, analytical laboratory waste, spent resins, spent carbon adsorbent, high-efficiency particulate air filters, and other process-related waste. Disposal would take place in an Integrated Disposal Facility. Excludes contaminated liquid effluent waste streams, which would be treated at the ETF.
[g] Totals may exceed 100 percent due to conservative estimates or rounded numbers. BBI percentages were rounded to the nearest tenth. The organic chemicals (acetonitrile, benzene, butanol, PCBs, and 2,4,6-TCP) may not total 100 percent because they would be destroyed during thermal treatment processes. Nitrate may not total 100 percent because it would be volatilized and released through the facility stack.
[h] No chemical constituents of potential concern have been reported in the cesium and strontium capsule secondary-waste streams.
[i] Derived from clean closure of all single-shell tank farms and the six sets of contiguous cribs and trenches (ditches). Disposal of PPF glass and retired PPF melters would take place in an Integrated Disposal Facility.
[j] Rubble, soil, and equipment would be generated by clean closure of all single-shell tank farms and six sets of contiguous cribs and trenches (ditches). Disposal would take place in the River Protection Project Disposal Facility.
[k] Includes the air emissions from all waste treatment processes, including those from treatment of the cesium and strontium capsules. For analysis purposes, both mercury capture and air emission releases were assumed.

Note: To convert kilograms to pounds, multiply by 2.2046
Key: %=percent; BBI=Best-Basis Inventory; butanol=n-butyl alcohol; ETF=Effluent Treatment Facility; HLW=high-level radioactive waste; IHLW=immobilized high-level radioactive waste; ILAW=immobilized low-activity waste; Kg=kilograms; LAW=low-activity waste; N/A=not applicable; NR=not reported; PCB=polychlorinated biphenyl; PPF=Preprocessing Facility; TCP=trichlorophenol.
Source: SAIC 2011.

Under Tank Closure Alternatives 6A and 6B, Base Cases (see Figure D–12 for a simplified flowsheet and Tables D–61 through D–64 for inventories), all 12 SST farms would undergo clean closure. Tank residual waste; materials; and highly contaminated rubble, soil, and equipment from tank and ancillary equipment removal activities would be packaged in shielded boxes, stored on site, and managed as IHLW glass. This waste represents 95 percent of the radioactive and chemical constituent inventory remaining in the tanks and the contaminated rubble, soil, and ancillary equipment resulting from leaks associated with waste retrieval. The waste would be managed and stored as IHLW in shielded containers on site. Only 5 percent of the inventory would be packaged and sent directly to the RPPDF.



Key: %=percent; HLW=high-level radioactive waste; IDF=Integrated Disposal Facility; PPF=Preprocessing Facility; RPPDF=River Protection Project Disposal Facility.

Figure D–12. Tank Closure Alternatives 6A and 6B, Base Cases, Clean Closure of Single-Shell Tank Farms Flowsheet

Table D–61. Tank Closure Alternative 6A, Base Case, Radioactive Constituents of Potential Concern Inventory from Clean Closure of the SST Farms (curies)

Analyte	MLLW[a]	PPF Glass and Retired PPF Melters[b]
Hydrogen-3 (tritium)	2.17×10^{2}	0
Carbon-14	2.36×10^{1}	0
Strontium-90	1.32×10^{5}	6.71×10^{4}
Technetium-99	1.78×10^{2}	1.38×10^{2}
Iodine-129	3.43×10^{-1}	5.43×10^{-2}
Cesium-137	2.62×10^{5}	2.08×10^{5}
Uranium-233, -234, -235, -238	1.02×10^{1}	7.83
Neptunium-237	6.68×10^{-1}	5.26×10^{-1}
Plutonium-239, -240	9.92×10^{1}	3.53×10^{1}

[a] Represents 5 percent of the contaminant inventory from the residual waste in the tanks, ancillary equipment, and soil contaminated by tank waste retrieval leaks and 65 percent of the contaminant inventory in deep soils for the SST farms. Disposal would take place in the River Protection Project Disposal Facility.

[b] Represents the portion of the 50 percent of the highly contaminated deep soil contaminant inventory that would be removed during clean closure of all of the SST farms and treated in the PPF, resulting in PPF glass and retired PPF melters. Disposal would take place in an Integrated Disposal Facility.

Key: MLLW=mixed low-level radioactive waste; PPF=Preprocessing Facility; SST=single-shell tank.

Source: SAIC 2011.

Table D–62. Tank Closure Alternative 6A, Base Case, Chemical Constituents of Potential Concern Inventory from Clean Closure of the SST Farms (kilograms)

Analyte	MLLW[a]	PPF Glass and Retired PPF Melters[b]
Chromium	4.10×10^{3}	8.52×10^{3}
Mercury	2.40	0
Nitrate	2.83×10^{5}	0
Lead	3.47×10^{2}	2.72×10^{2}
Total uranium	7.66×10^{3}	1.62×10^{4}
Acetonitrile	1.47	0
Benzene	1.20×10^{-4}	0
Butanol (n-butyl alcohol)	6.29×10^{2}	0
Polychlorinated biphenyls	2.82×10^{-1}	0
2,4,6-Trichlorophenol	5.54×10^{-5}	0

[a] Represents 5 percent of the contaminant inventory from the residual waste in the tanks, ancillary equipment, and soil contaminated by tank waste retrieval leaks and 40.5 percent of the contaminant inventory in deep soils for the SST farms. Disposal would take place in the River Protection Project Disposal Facility.

[b] Represents the portion of the 85 percent of the highly contaminated deep soil contaminant inventory that would be removed during clean closure of all of the SST farms and treated in the PPF, resulting in PPF glass and retired PPF melters. Disposal would take place in an Integrated Disposal Facility.

Note: To convert kilograms to pounds, multiply by 2.2046.

Key: MLLW=mixed low-level radioactive waste; PPF=Preprocessing Facility; SST=single-shell tank.

Source: SAIC 2011.

Table D–63. Tank Closure Alternative 6B, Base Case, Radioactive Constituents of Potential Concern Inventory from Clean Closure of the SST Farms (curies)

Analyte	MLLW[a]	PPF Glass and Retired PPF Melters[b]
Hydrogen-3 (tritium)	2.17×10^{2}	0
Carbon-14	2.36×10^{1}	0
Strontium-90	1.32×10^{5}	6.57×10^{4}
Technetium-99	1.78×10^{2}	1.35×10^{2}
Iodine-129	3.43×10^{-1}	5.31×10^{-2}
Cesium-137	2.62×10^{5}	2.03×10^{5}
Uranium-233, -234, -235, -238	1.02×10^{1}	7.66
Neptunium-237	6.68×10^{-1}	5.14×10^{-1}
Plutonium-239, -240	9.92×10^{1}	3.45×10^{1}

[a] Represents 5 percent of the contaminant inventory from the residual waste in the tanks, ancillary equipment, and soil contaminated by tank waste retrieval leaks and 65 percent of the contaminant inventory in deep soils for the SST farms. Disposal would take place in the River Protection Project Disposal Facility.

[b] Represents the portion of the 50 percent of the highly contaminated deep soil contaminant inventory that would be removed during clean closure of all of the SST farms and treated in the PPF, resulting in PPF glass and retired PPF melters. Disposal would take place in an Integrated Disposal Facility.

Key: MLLW=mixed low-level radioactive waste; PPF=Preprocessing Facility; SST=single-shell tank.

Source: SAIC 2011.

Table D–64. Tank Closure Alternative 6B, Base Case, Chemical Constituents of Potential Concern Inventory from Clean Closure of the SST Farms (kilograms)

Analyte	MLLW[a]	PPF Glass and Retired PPF Melters[b]
Chromium	4.10×10^{3}	8.33×10^{3}
Mercury	2.40	0
Nitrate	2.83×10^{5}	0
Lead	3.47×10^{2}	2.66×10^{2}
Total uranium	7.66×10^{3}	1.59×10^{4}
Acetonitrile	1.47	0
Benzene	1.20×10^{-4}	0
Butanol (n-butyl alcohol)	6.29×10^{2}	0
Polychlorinated biphenyls	2.82×10^{-1}	0
2,4,6-Trichlorophenol	5.54×10^{-5}	0

[a] Represents 5 percent of the contaminant inventory from the residual waste in the tanks, ancillary equipment, and soil contaminated by tank waste retrieval leaks and 40.5 percent of the contaminant inventory in deep soils for the SST farms. Disposal would take place in the River Protection Project Disposal Facility.

[b] Represents the portion of the 85 percent of the highly contaminated deep soil contaminant inventory that would be removed during clean closure of all of the SST farms and treated in the PPF, resulting in PPF glass and retired PPF melters. Disposal would take place in an Integrated Disposal Facility.

Note: To convert kilograms to pounds, multiply by 2.2046.

Key: MLLW=mixed low-level radioactive waste; PPF=Preprocessing Facility; SST=single-shell tank.

Source: SAIC 2011.

Soils contaminated from past tank leaks would be removed and managed as described above for Tank Closure Alternative 4. Moderately contaminated soil containing 30 percent of the radionuclide and chemical inventories would be packaged for direct disposal in the RPPDF. Heavily contaminated soil containing 70 percent of the radionuclide and chemical inventories would be processed through soil washing in the PPF. In the PPF, 85 percent of the chemical constituents and 50 percent of the radioactive constituents would be removed from the soil in a liquid waste stream. This liquid waste stream would be further processed in the PPF into PPF glass for onsite storage in an Integrated Disposal Facility (IDF). This liquid waste stream represents 35 percent of the radioactive constituents and 59 percent of the chemical constituents from past leaks. The remaining inventory of contaminants, 35 percent of the initial contaminated soil radionuclide inventory (50 percent of the 70 percent sent to the PPF), and 11 percent of the initial contaminated chemical inventory (15 percent of the 70 percent sent to the PPF) would be managed as MLLW generated by PPF operations. Thus, a total of 65 percent of the inventory of radioactive constituents and 41 percent of the inventory of chemical constituents from past tank leaks would be disposed of in the RPPDF.

The inventories associated with the soil disposed of on site are determined as shown in the following equations:

$$M\text{rad}_{\text{soil}} = 0.65 \times M_{\text{pleak}}$$

and

$$M\text{chem}_{\text{soil}} = 0.41 \times M_{\text{pleak}}$$

where:

$M\text{rad}_{\text{soil}}$ = inventory of radioactive constituents in contaminated soil disposed of on site

M_{pleak} = inventory of radioactive or chemical constituents from past leaks

$M\text{chem}_{\text{soil}}$ = inventory of chemical constituents in contaminated soil disposed of on site

For the Option Cases under Tank Closure Alternatives 6A and 6B, the soils contaminated from intentional discharges to the six sets of cribs and trenches (ditches) would be added to the inventories from the 12 SST farms. Tables D–65 through D–68 show estimates of radioactive and chemical constituent inventories resulting from clean closure of the SST Farms and the six sets of cribs and trenches (ditches), respectively.

Table D–65. Tank Closure Alternative 6A, Option Case, Radioactive Constituents of Potential Concern Inventory from Clean Closure of the SST Farms and Six Sets of Cribs and Trenches (Ditches) (curies)

Analyte	MLLW[a]	PPF Glass and Retired PPF Melters[b]
Hydrogen-3 (tritium)	3.79×10^{3}	0
Carbon-14	3.35×10^{1}	0
Strontium-90	1.39×10^{5}	7.84×10^{4}
Technetium-99	2.70×10^{2}	3.44×10^{2}
Iodine-129	4.96×10^{-1}	1.23×10^{-1}
Cesium-137	2.72×10^{5}	2.20×10^{5}
Uranium-233, -234, -235, -238	1.42×10^{1}	1.69×10^{1}
Neptunium-237	1.60	2.67
Plutonium-239, -240	4.85×10^{2}	9.39×10^{2}

[a] Represents 5 percent of the contaminant inventory from the residual waste in the tanks, ancillary equipment, and soil contaminated by tank waste retrieval leaks and 65 percent of the contaminant inventory in deep soils for the SST farms and the six sets of contiguous cribs and trenches (ditches). Disposal would take place in the River Protection Project Disposal Facility.

[b] Represents the portion of the 50 percent of the highly contaminated deep soil contaminant inventory that would be removed during clean closure of all of the SST farms and the six sets of contiguous cribs and trenches (ditches) and treated in the PPF, resulting in PPF glass and retired PPF melters. Disposal would take place in an Integrated Disposal Facility.

Key: MLLW=mixed low-level radioactive waste; PPF=Preprocessing Facility; SST=single-shell tank.

Source: SAIC 2011.

Table D–66. Tank Closure Alternative 6A, Option Case, Chemical Constituents of Potential Concern Inventory from Clean Closure of the SST Farms and Six Sets of Cribs and Trenches (Ditches) (kilograms)

Analyte	MLLW[a]	PPF Glass and Retired PPF Melters[b]
Chromium	3.69×10^{4}	1.60×10^{5}
Mercury	1.59×10^{1}	0
Nitrate	1.04×10^{7}	0
Lead	3.58×10^{2}	3.11×10^{2}
Total uranium	9.24×10^{3}	2.28×10^{4}
Acetonitrile	1.47	0
Benzene	1.20×10^{-4}	0
Butanol (n-butyl alcohol)	6.29×10^{2}	0
Polychlorinated biphenyls	2.82×10^{-1}	0
2,4,6-Trichlorophenol	5.54×10^{-5}	0

[a] Represents 5 percent of the contaminant inventory from the residual waste in the tanks, ancillary equipment, and soil contaminated by tank waste retrieval leaks and 40.5 percent of the contaminant inventory in deep soils for the SST farms and the six sets of contiguous cribs and trenches (ditches). Disposal would take place in the River Protection Project Disposal Facility.

[b] Represents the portion of the 85 percent of the highly contaminated deep soil contaminant inventory that would be removed during clean closure of all of the SST farms and the six sets of contiguous cribs and trenches (ditches) and treated in the PPF, resulting in PPF glass and retired PPF melters. Disposal would take place in an Integrated Disposal Facility.

Note: To convert kilograms to pounds, multiply by 2.2046.

Key: MLLW=mixed low-level radioactive waste; PPF=Preprocessing Facility; SST=single-shell tank.

Source: SAIC 2011.

Table D–67. Tank Closure Alternative 6B, Option Case, Radioactive Constituents of Potential Concern Inventory from Clean Closure of the SST Farms and Six Sets of Cribs and Trenches (Ditches) (curies)

Analyte	MLLW[a]	PPF Glass and Retired PPF Melters[b]
Hydrogen-3 (tritium)	3.79×10^{3}	0
Carbon-14	3.35×10^{1}	0
Strontium-90	1.39×10^{5}	7.80×10^{4}
Technetium-99	2.70×10^{2}	3.42×10^{2}
Iodine-129	4.96×10^{-1}	1.23×10^{-1}
Cesium-137	2.72×10^{5}	2.19×10^{5}
Uranium-233, -234, -235, -238	1.42×10^{1}	1.68×10^{1}
Neptunium-237	1.60	2.66
Plutonium-239, -240	4.85×10^{2}	9.34×10^{2}

[a] Represents 5 percent of the contaminant inventory from the residual waste in the tanks, ancillary equipment, and soil contaminated by tank waste retrieval leaks and 65 percent of the contaminant inventory in deep soils for the SST farms and the six sets of contiguous cribs and trenches (ditches). Disposal would take place in the River Protection Project Disposal Facility.

[b] Represents the portion of the 50 percent of the highly contaminated deep soil contaminant inventory that would be removed during clean closure of all of the SST farms and the six sets of contiguous cribs and trenches (ditches) and treated in the PPF, resulting in PPF glass and retired PPF melters. Disposal would take place in an Integrated Disposal Facility.

Key: MLLW=mixed low-level radioactive waste; PPF=Preprocessing Facility; SST=single-shell tank.

Source: SAIC 2011.

Table D–68. Tank Closure Alternative 6B, Option Case, Chemical Constituents of Potential Concern Inventory from Clean Closure of the SST Farms and Six Sets of Cribs and Trenches (Ditches) (kilograms)

Analyte	MLLW[a]	PPF Glass and Retired PPF Melters[b]
Chromium	3.69×10^{4}	1.58×10^{5}
Mercury	1.59×10^{1}	0
Nitrate	1.04×10^{7}	0
Lead	3.58×10^{2}	3.09×10^{2}
Total uranium	9.24×10^{3}	2.26×10^{4}
Acetonitrile	1.47	0
Benzene	1.20×10^{-4}	0
Butanol (n-butyl alcohol)	6.29×10^{2}	0
Polychlorinated biphenyls	2.82×10^{-1}	0
2,4,6-Trichlorophenol	5.54×10^{-5}	0

[a] Represents 5 percent of the contaminant inventory from the residual waste in the tanks, ancillary equipment, and soil contaminated by tank waste retrieval leaks and 40.5 percent of the contaminant inventory in deep soils for the SST farms and the six sets of contiguous cribs and trenches (ditches). Disposal would take place in the River Protection Project Disposal Facility.

[b] Represents the portion of the 85 percent of the highly contaminated deep soil contaminant inventory that would be removed during clean closure of all of the SST farms and the six sets of contiguous cribs and trenches (ditches) and treated in the PPF, resulting in PPF glass and retired PPF melters. Disposal would take place in an Integrated Disposal Facility.

Note: To convert kilograms to pounds, multiply by 2.2046.

Key: MLLW=mixed low-level radioactive waste; PPF=Preprocessing Facility; SST=single-shell tank.

Source: SAIC 2011.

Waste would be treated the same under Tank Closure Alternatives 6B and 6C; however, the SSTs would be landfill-closed, not clean-closed, under Alternative 6C. The process schematic and material balance summaries under Alternative 6C are presented in Figure D–11 and Tables D–69 and D–70.

Table D–69. Tank Closure Alternative 6C Radioactive Constituents of Potential Concern Balance

	Iodine-129		Cesium-137		Carbon-14		Hydrogen-3 (Tritium)		Uranium-233, -234, -235, -238		Neptunium-237		Plutonium -239, -240		Strontium-90		Technetium-99	
	Curies	% of BBI	Curies	% of BBI	Curies	% of BBI	Curies	% of BBI	Curies	% of BBI	Curies	% of BBI	Curies	% of BBI	Curies	% of BBI	Curies	% of BBI
Best-Basis Inventory																		
BBI[a]	4.82×10^{1}	N/A	4.58×10^{7}	N/A	3.12×10^{3}	N/A	1.21×10^{4}	N/A	9.38×10^{2}	N/A	1.41×10^{2}	N/A	8.14×10^{4}	N/A	5.05×10^{7}	N/A	2.97×10^{4}	N/A
Tank Closure Waste Inventory																		
Tank residual waste[b]	4.82×10^{-1}	1.0	4.58×10^{5}	1.0	3.12×10^{1}	1.0	1.21×10^{2}	1.0	9.38	1.0	1.41	1.0	8.14×10^{2}	1.0	5.05×10^{5}	1.0	2.97×10^{2}	1.0
IHLW glass[c]	6.99×10^{-3}	0.0	4.49×10^{7}	97.9	0	0.0	0	0.0	8.73×10^{2}	93.1	1.40×10^{2}	99.0	8.06×10^{4}	99.0	4.93×10^{7}	97.6	2.73×10^{2}	0.9
ILAW glass and retired LAW melters[d]	9.56	19.8	4.45×10^{5}	1.0	0	0.0	0	0.0	5.47×10^{1}	5.8	8.35×10^{-3}	0.0	1.45	0.0	2.30×10^{3}	0.0	2.88×10^{4}	96.9
ETF-generated solid secondary waste[e]	3.36×10^{1}	69.7	4.59×10^{-1}	0.0	8.51	0.3	0	0.0	4.03×10^{-2}	0.0	5.11×10^{-2}	0.0	6.90×10^{-4}	0.0	6.42	0.0	8.63×10^{1}	0.3
Solid secondary waste[f]	4.65	9.7	1.95×10^{5}	0.4	0	0.0	0	0.0	3.64	0.4	2.83×10^{-1}	0.2	1.98×10^{2}	0.2	7.76×10^{5}	1.5	4.31×10^{2}	1.5
Total[g]	**4.83×10^{1}**	**100.2**	**4.60×10^{7}**	**100.2**	**3.97×10^{1}**	**1.3**	**1.21×10^{2}**	**1.0**	**9.41×10^{2}**	**100.3**	**1.41×10^{2}**	**100.2**	**8.16×10^{4}**	**100.2**	**5.06×10^{7}**	**100.1**	**2.99×10^{4}**	**100.5**
Other Inventory																		
Solid and liquid secondary waste from cesium and strontium capsules	0	N/A	1.99×10^{5}	N/A	0	N/A	0	N/A	0	N/A	0	N/A	0	N/A	3.16×10^{5}	N/A	0	N/A
Cesium and strontium capsules[h]	0	N/A	4.59×10^{7}	N/A	0	N/A	0	N/A	0	N/A	0	N/A	0	N/A	1.98×10^{7}	N/A	0	N/A
Rubble, soil, and equipment[i]	1.67×10^{-2}	N/A	1.31×10^{4}	N/A	1.47	N/A	6.03	N/A	4.82×10^{-1}	N/A	3.24×10^{-2}	N/A	4.32×10^{1}	N/A	3.05×10^{4}	N/A	9.72	N/A
Air Emissions																		
Treatment air emissions[j]	4.78×10^{1}	N/A	4.69×10^{4}	N/A	3.10×10^{3}	N/A	1.20×10^{4}	N/A	4.66×10^{-1}	N/A	NR	N/A	4.04×10^{1}	N/A	3.55×10^{4}	N/A	1.47×10^{1}	N/A

[a] Source of BBI data is *Inventory and Source Term Data Package*, DOE-ORP-2003-02, Rev. 0 (DOE 2003a).

[b] Represents 99.0 percent retrieval. For analysis purposes, waste inventories from tank waste retrieval leaks and ancillary equipment were assumed to be treated in the Waste Treatment Plant.

[c] To be stored on site until disposition decisions are made and implemented. This inventory would include the retired HLW melters.

[d] Although processed as ILAW glass, glass and retired melters would be managed and disposed of as IHLW.

[e] Includes secondary liquids that would be sent to the ETF and treated; solids would be disposed of in an Integrated Disposal Facility. Excludes liquid secondary waste from the processing of cesium and strontium capsules, which would be reported separately.

[f] Includes solid low-level radioactive waste and mixed low-level radioactive waste streams that would be generated by waste treatment operations. Such waste streams would include debris waste, melter consumables, failed process components, analytical laboratory waste, spent resins, spent carbon adsorbent, high-efficiency particulate air filters, and other process-related waste. Excludes contaminated liquid effluent waste streams, which would be treated at the ETF.

[g] Totals may exceed 100 percent due to conservative estimates or rounded numbers. BBI percentages were rounded to the nearest tenth. Carbon-14 and hydrogen-3 (tritium) may not total 100 percent because a portion of each would be released to the offgas streams and stack, and a portion (ETF-generated liquid) would be disposed of in the State-Approved Land Disposal Site.

[h] To be treated in the Waste Treatment Plant, resulting in glass waste, which would be stored on site until disposition decisions are made and implemented.

[i] Rubble, soil, and equipment would be generated by removal of 4.6 meters (15 feet) of soil and ancillary equipment at the BX and SX tank farms. Disposal would take place in the River Protection Project Disposal Facility.

[j] Includes air emissions from all waste treatment processes, including those from treatment of the cesium and strontium capsules. For analysis purposes, both iodine-129 capture and air emission releases were assumed.

Key: %=percent; BBI=Best-Basis Inventory; ETF=Effluent Treatment Facility; HLW=high-level radioactive waste; IHLW=immobilized high-level radioactive waste; ILAW=immobilized low-activity waste; LAW=low-activity waste; N/A=not applicable; NR=not reported.

Source: SAIC 2011.

Table D–70. Tank Closure Alternative 6C Chemical Constituents of Potential Concern Balance

	Chromium		Mercury		Nitrate		Lead		Total Uranium		Acetonitrile		Benzene		Butanol		PCBs		2,4,6-TCP	
	Kg	% of BBI	Kg	% of BBI	Kg	% of BBI	Kg	% of BBI	Kg	% of BBI	Kg	% of BBI	Kg	% of BBI	Kg	% of BBI	Kg	% of BBI	Kg	% of BBI
Best-Basis Inventory																				
BBI[a]	5.98×10^{5}	N/A	1.83×10^{3}	N/A	7.08×10^{7}	N/A	8.41×10^{4}	N/A	5.97×10^{5}	N/A	2.95×10^{4}	N/A	2.40	N/A	3.45×10^{6}	N/A	1.68×10^{3}	N/A	1.11	N/A
Tank Closure Waste Inventory																				
Tank residual waste[b]	5.98×10^{3}	1.0	1.83×10^{1}	1.0	7.08×10^{5}	1.0	8.41×10^{2}	1.0	5.97×10^{3}	1.0	2.95×10^{2}	1.0	2.40×10^{-2}	1.0	3.45×10^{4}	1.0	1.68×10^{1}	1.0	1.11×10^{-2}	1.0
IHLW glass[c]	1.36×10^{5}	22.7	0	0.0	0	0.0	7.45×10^{4}	88.6	5.52×10^{5}	92.5	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
ILAW glass and retired LAW melters[d]	4.56×10^{5}	76.2	0	0.0	0	0.0	8.88×10^{3}	10.6	3.74×10^{4}	6.3	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
ETF-generated solid secondary waste[e]	4.43×10^{1}	0.0	5.55	0.3	9.01×10^{6}	12.7	4.58	0.0	4.00×10^{1}	0.0	NR	N/A	NR	N/A	NR	N/A	NR	N/A	NR	N/A
Solid secondary waste[f]	1.94×10^{3}	0.3	1.76×10^{3}	96.4	0	0.0	2.47×10^{2}	0.3	2.32×10^{3}	0.4	NR	N/A	NR	N/A	NR	N/A	NR	N/A	NR	N/A
Total[g]	**6.00×10^{5}**	**100.3**	**1.78×10^{3}**	**97.7**	**9.72×10^{6}**	**13.7**	**8.45×10^{4}**	**100.5**	**5.98×10^{5}**	**100.2**	**2.95×10^{2}**	**1.0**	**2.40×10^{-2}**	**1.0**	**3.45×10^{4}**	**1.0**	**1.68×10^{1}**	**1.0**	**1.11×10^{-2}**	**1.0**
Other Inventory[h]																				
Rubble, soil, and equipment[i]	5.86×10^{2}	N/A	2.22	N/A	3.93×10^{4}	N/A	3.34×10^{1}	N/A	6.60×10^{2}	N/A	NR	N/A	NR	N/A	NR	N/A	NR	N/A	NR	N/A
Air Emissions																				
Treatment air emissions[j]	NR	N/A	1.81×10^{3}	N/A	NR	N/A	NR	N/A	NR	N/A	NR	N/A	6.14×10^{2}	N/A	NR	N/A	NR	N/A	NR	N/A

[a] Source of BBI data is *Inventory and Source Term Data Package*, DOE-ORP-2003-02, Rev. 0 (DOE 2003a).

[b] Represents 99.0 percent retrieval. For analysis purposes, waste inventories from tank waste retrieval leaks and ancillary equipment were assumed to be treated in the Waste Treatment Plant.

[c] To be stored on site until disposition decisions are made and implemented. This inventory would include the retired HLW melters.

[d] Although processed as ILAW glass, glass and retired melters would be managed and disposed of as IHLW.

[e] Includes secondary liquids that would be sent to the ETF and treated; solids would be disposed of in an Integrated Disposal Facility.

[f] Includes solid low-level radioactive waste and mixed low-level radioactive waste streams that would be generated by the waste treatment operations. Such waste streams would include debris waste, melter consumables, failed process components, analytical laboratory waste, spent resins, spent carbon adsorbent, high-efficiency particulate air filters, and other process-related waste. Excludes contaminated liquid effluent waste streams, which would be treated at the ETF.

[g] Totals may exceed 100 percent due to conservative estimates or rounded numbers. BBI percentages were rounded to the nearest tenth. The organic chemicals (acetonitrile, benzene, butanol, PCBs, and 2,4,6-TCP) may not total 100 percent because they would be destroyed during thermal treatment processes. Nitrate may not total 100 percent because it would be volatilized and released through the facility stack.

[h] No chemical constituents of potential concern have been reported in the cesium and strontium capsule secondary-waste streams.

[i] Rubble, soil, and equipment would be generated by removal of 4.6 meters (15 feet) of soil and ancillary equipment at the BX and SX tank farms. Disposal would take place in the River Protection Project Disposal Facility.

[j] Includes the air emissions from all waste treatment processes, including those from treatment of the cesium and strontium capsules. For analysis purposes, both mercury capture and air emission releases were assumed.

Note: To convert kilograms to pounds, multiply by 2.2046.

Key: %=percent; BBI=Best-Basis Inventory; butanol=n-butyl alcohol; ETF=Effluent Treatment Facility; HLW=high-level radioactive waste; IHLW=immobilized high-level radioactive waste; ILAW=immobilized low-activity waste; Kg=kilograms; LAW=low-activity waste; N/A=not applicable; NR=not reported; PCB=polychlorinated biphenyl; TCP=trichlorophenol.

Source: SAIC 2011.

For the purpose of long-term impact assessment, constituent inventory estimates are required for three categories of soil: surface, near surface, and deep soil. Surface soil is defined as soil located between 0.15 and 0.3 meters (0.5 and 1 foot) of the surface. For long-term impacts, surface soil constituent inventories are expected to be minor for three reasons. First, surface contamination occurs primarily due to spills, and current operating procedures call for prompt remediation. Second, during the 1990s, a layer of clean soil was placed over the tank farms to reduce the dose to workers. Third, under all Tank Closure alternatives except Alternatives 1 and 2A, all tank farms would be capped or backfilled with clean soil. Near-surface soil is defined as soil located between 0.3 and 4.6 meters (1 and 15 feet) of the surface. Inventories in this category are dominated by the contributions of ancillary equipment, as described in Section D.1.2. Finally, deep soil is defined as soil located at depths greater than 4.6 meters (15 feet). Contamination of deep soil is expected to be due to past leaks, discharges to cribs and trenches (ditches), and tank waste retrieval leaks, for which inventory estimates are presented in Sections D.1.4, D.1.5, and D.1.6, respectively.

During closure of the tank farms, combinations of the three categories of soil would be disposed of on site, either with or without additional cleaning. Inventories of radioactive and chemical constituents projected under each of the Tank Closure alternatives are presented in the following section in conjunction with inventories of the waste forms proposed for waste disposal.

As discussed in Chapter 2, under Tank Closure Alternatives 2B, 3A, 3B, 3C, and 6C, contaminated soil would be removed (upper 4.6 meters [15 feet]) at the BX and SX tank farms only. Under Tank Closure Alternative 4, the BX and SX tank farms would be clean-closed; clean closure would include disposal of ancillary equipment and contaminated soils. Under Tank Closure Alternatives 6A and 6B, Base Cases, all SST farms would be clean-closed; as under Alternative 4, clean closure would include disposal of ancillary equipment and contaminated soils. In addition, Tank Closure Alternatives 6A and 6B include an analysis of expansion of clean closure to include the six sets of contiguous cribs and trenches (ditches) in addition to the SST farms. Therefore, three contaminated-soil onsite disposal analyses were conducted using current tank, ancillary equipment, tank residual, retrieval, and past leak inventory data. The bases for these calculations are the process options described in the scaled data documentation prepared for this *TC & WM EIS* (SAIC 2010a). These options involve the different types of waste, recovery efficiencies, and combinations of processing under each alternative. Material balances reflecting these process options were developed using the analysis described in the following paragraphs.

For Tank Closure Alternatives 2B, 3A, 3B, 3C, and 6C (see Figure D–13 for a simplified flowsheet and Tables D–71 and D–72 for inventories), the following calculation was used to determine the radioactive and chemical constituent inventories that would be associated with removal of soil and ancillary equipment within 4.6 meters (15 feet) of the ground surface at the BX and SX tank farms. The calculation is based on the assumptions that the inventory of contaminants excluding ancillary equipment would be minor compared with the inventory of contaminants including ancillary equipment, and that all of the recovered soil, ancillary equipment, and associated inventory of contaminants would be packaged for disposal in the RPPDF. The inventory of contaminants was calculated as follows:

$$M_{\text{soil}} = 1.0 \times M_{\text{anc}}$$

where:

M_{soil} = inventory of radioactive or chemical constituents in contaminated equipment and soil disposed of on site

M_{anc} = inventory of radioactive or chemical constituents in ancillary equipment

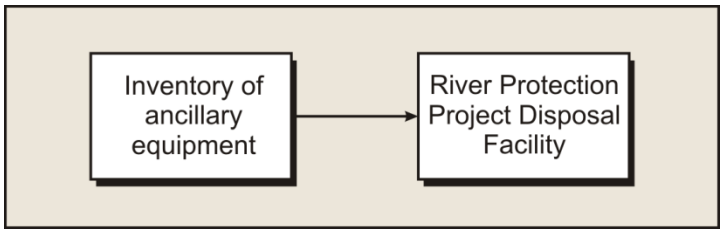


Figure D–13. Tank Closure Alternatives 2B, 3A, 3B, 3C, and 6C Contaminated Soil Removal at BX and SX Tank Farms Flowsheet

Table D–71. Tank Closure Alternatives 2B, 3A, 3B, 3C, and 6C Radioactive COPC Inventory from Removal of 4.6 Meters (15 Feet) of Soil at the BX and SX Tank Farms (curies)

Analyte	MLLW[a]
Hydrogen-3 (tritium)	6.03
Carbon-14	1.47
Strontium-90	3.05×10^{4}
Technetium-99	9.72
Iodine-129	1.67×10^{-2}
Cesium-137	1.31×10^{4}
Uranium-233, -234, -235, -238	4.82×10^{-1}
Neptunium-237	3.24×10^{-2}
Plutonium-239, -240	4.32×10^{1}

[a] Represents 100 percent of the ancillary equipment inventory in BX and SX tank farms. Disposal would take place in the River Protection Project Disposal Facility.

Key: COPC=constituent of potential concern; MLLW=mixed low-level radioactive waste.

Source: SAIC 2011.

Table D–72. Tank Closure Alternatives 2B, 3A, 3B, 3C, and 6C Chemical COPC Inventory from Removal of 4.6 Meters (15 Feet) of Soil at the BX and SX Tank Farms (kilograms)

Analyte	MLLW[a]
Chromium	5.86×10^{2}
Mercury	2.22
Nitrate	3.93×10^{4}
Lead	3.34×10^{1}
Total uranium	6.60×10^{2}
Acetonitrile	NR
Benzene	NR
Butanol (n-butyl alcohol)	NR
Polychlorinated biphenyls	NR
2,4,6-Trichlorophenol	NR

[a] Represents 100 percent of the ancillary equipment inventory in BX and SX tank farms. Disposal would take place in the River Protection Project Disposal Facility.

Note: To convert kilograms to pounds, multiply by 2.2046.

Key: COPC=constituent of potential concern; MLLW=mixed low-level radioactive waste; NR=not reported.

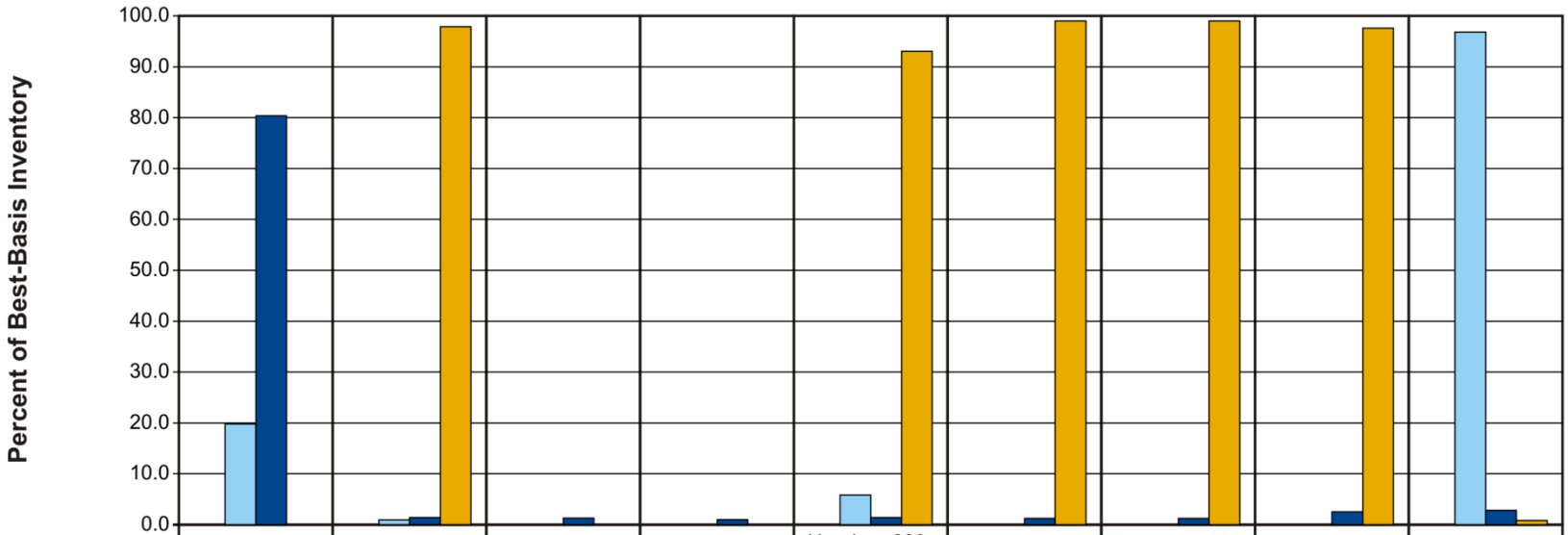
Source: SAIC 2011.

D.1.8 Distribution of Radioactive Constituents of Potential Concern Under Tank Closure Alternatives

As discussed in Section D.1.7, the retrieval of tank waste, treatment and stabilization of waste streams, and closure of the tank farms would generate a number of waste forms for both on- and offsite disposal. This section provides both a graphic representation and tabular information on the radioactive COPC inventories for each of the Tank Closure alternatives. Figures D–14 through D–63 (a total of 50 figures) below show the distribution of the nine radioactive COPCs under Tank Closure Alternatives 2A, 2B, 3A, 3B, 3C, 4, 5, the 6A Base and Option Cases, the 6B Base and Option Cases, and 6C (SAIC 2011). These figures include the following for each of the Tank Closure action alternatives:

- A histogram that provides a graphic display of the distribution of the nine radioactive COPCs (iodine-129, cesium-137, carbon-14, tritium, uranium [including uranium-233, -234, -235, and -238], neptunium-237, plutonium [including plutonium-239 and -240], strontium-90, and technetium-99). For each of these COPCs, the histogram provides the total curies in the tank farms (BBI estimate) and the estimated BBI percentage (curie basis) that would be disposed of on site in an IDF as either a glass waste form (ILAW glass, bulk vitrification glass), a grout (cast stone waste, retired LAW melters [grout filled], Effluent Treatment Facility [ETF]–generated solid secondary waste, sulfate grout waste, or tank residual waste), or steam reforming waste. As noted on the histograms, only tank closure waste is included. The histogram excludes waste generated by the FFTF Decommissioning and Waste Management alternatives; offsite waste; onsite non–Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), nontank waste; cesium and strontium capsule waste; waste forms that would be disposed of in the RPPDF; and PPF-generated waste that would contribute to the IHLW glass and ILAW glass.
- Three pie charts that graphically display the disposition of three radioactive COPCs (iodine-129, uranium [including uranium-233, -234, -235, and -238], and technetium-99) under each Tank Closure alternative. As noted on the pie charts, only tank closure waste is included. The pie charts exclude waste generated by the FFTF Decommissioning and Waste Management alternatives; offsite waste; onsite non-CERCLA, nontank waste; cesium and strontium capsule waste; the waste forms that would be disposed of in the RPPDF; and PPF-generated waste that would contribute to the IHLW glass and ILAW glass.
- One summary pie chart that includes all nine radioactive COPCs (iodine-129, cesium-137, carbon-14, tritium, uranium [including uranium-233, -234, -235, and -238], neptunium-237, plutonium [including plutonium-239 and -240], strontium-90, and technetium-99) and displays the disposition of the total of these COPCs under each Tank Closure alternative. As noted on the pie charts, only tank closure waste is included. This pie chart excludes waste generated by the FFTF Decommissioning and Waste Management alternatives; offsite waste; onsite non-CERCLA, nontank waste; cesium and strontium capsule waste; the waste forms that would be disposed of in the RPPDF; and PPF-generated waste that would contribute to the IHLW glass and ILAW glass.

The figures in this section reflect the assumption that IHLW would be disposed of off site (however, this IHLW would be stored on site until disposition decisions are made and implemented). As indicated in its fiscal year 2010 budget request, the Administration terminated the Yucca Mountain program. Notwithstanding the decision to terminate the Yucca Mountain program, DOE remains committed to meeting its obligations to manage and ultimately dispose of HLW and SNF. The Administration convened a Blue Ribbon Commission on America's Nuclear Future in March 2010 to evaluate alternative approaches for meeting these obligations. The commission provides the opportunity for a meaningful dialogue on how best to address this challenging issue and will provide recommendations that will form the basis for working with Congress to revise the statutory framework for managing and disposing of HLW and SNF.



	Iodine-129	Cesium-137[a]	Carbon-14	Hydrogen-3 (Tritium)	Uranium-233, -234, -235, -238	Neptunium-237	Plutonium-239, -240	Strontium-90[a]	Technetium-99
Best-Basis Inventory (curies)	4.82×10^{1}	4.58×10^{7}	3.12×10^{3}	1.21×10^{4}	9.38×10^{2}	1.41×10^{2}	8.14×10^{4}	5.05×10^{7}	2.97×10^{4}
% disposal									
Onsite (glass)[b]	19.8	1.0	0.0	0.0	5.8	0.0	0.0	0.0	96.9
Onsite (grout)[c]	80.4	1.4	1.3	1.0	1.4	1.2	1.2	2.5	2.8
Offsite (glass)[d]	0.0	97.9	0.0	0.0	93.1	99.0	99.0	97.6	0.8
Total[e]	100.2	100.2	1.3	1.0	100.3	100.2	100.2	100.1	100.5

[a] This figure excludes the inventory and secondary waste generated by the treatment of the cesium and strontium capsules.
[b] Immobilized low-activity waste glass.
[c] Tank residuals, retired low-activity waste melters, solid secondary waste, and Effluent Treatment Facility–generated solid secondary waste.
[d] Immobilized high-level radioactive waste glass.
[e] Totals may exceed 100 percent due to conservative estimates or rounded numbers. Totals may not equal the sum of the contributions due to rounding. Carbon-14 and hydrogen-3 (tritium) may not total 100 percent because portions of each would be released to the offgas streams and stack(s) or to the State-Approved Land Disposal Site.

Note: Only Tank Closure Alternative 2A waste is included. FFTF Decommissioning alternative waste; Waste Management alternative waste; and offsite- and onsite-generated, non-Comprehensive Environmental Response, Compensation, and Liability Act, nontank waste are excluded.
Key: %=percent; FFTF=Fast Flux Test Facility.

Figure D–14. Tank Closure Alternative 2A Distribution of Radioactive Constituents of Potential Concern

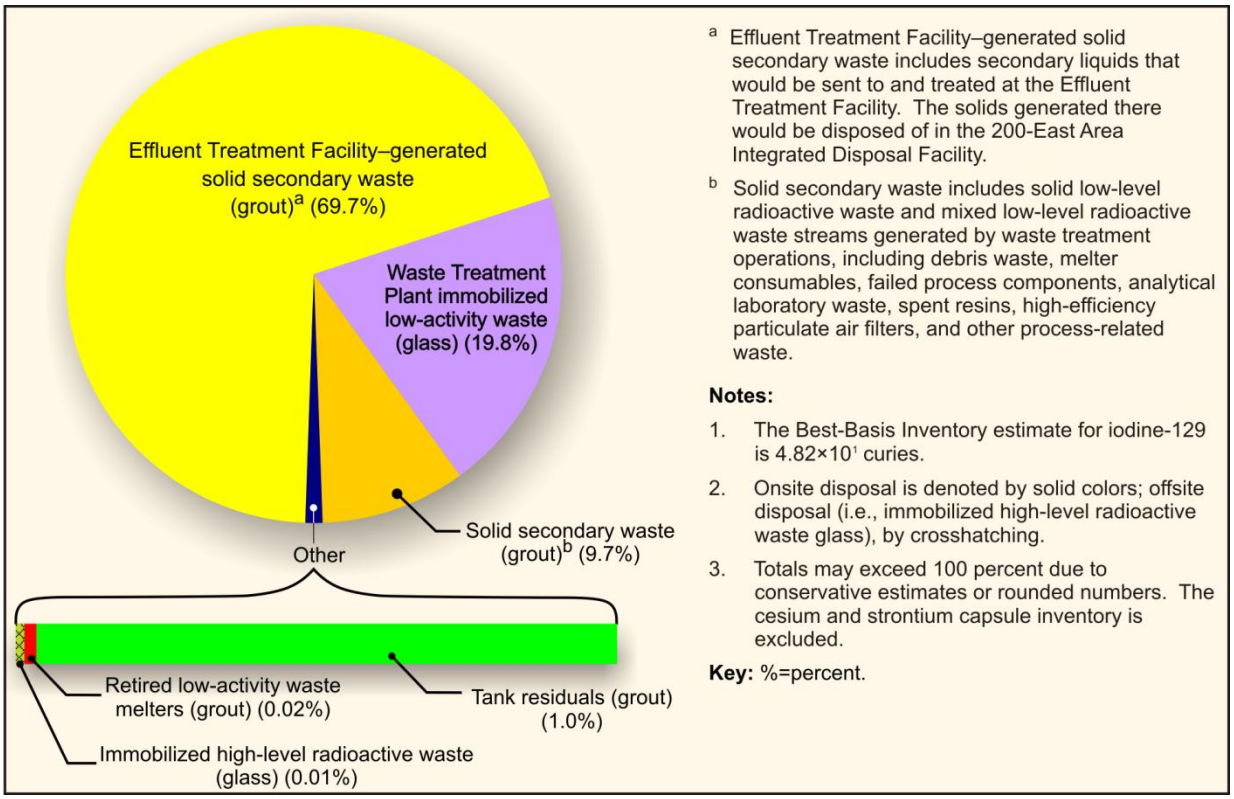


Figure D–15. Tank Closure Alternative 2A Iodine-129 Distribution

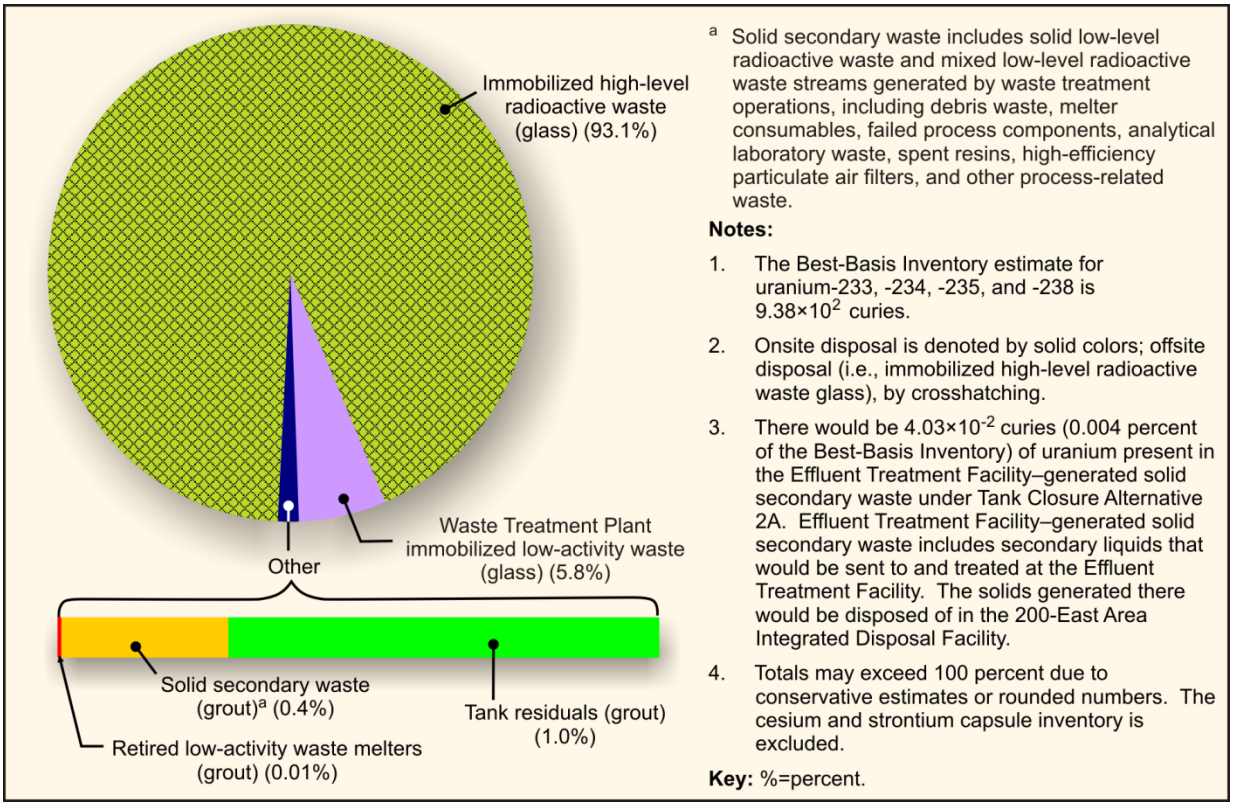


Figure D–16. Tank Closure Alternative 2A Uranium Distribution

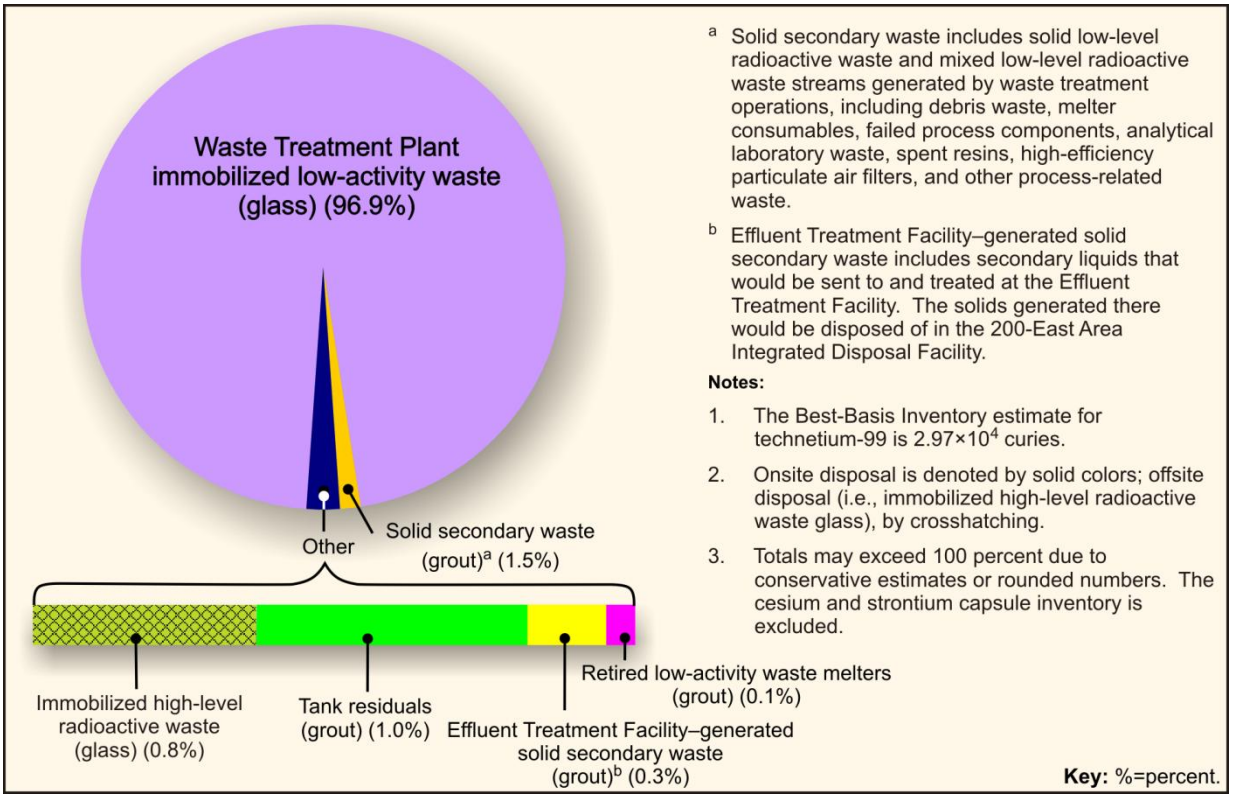


Figure D–17. Tank Closure Alternative 2A Technetium-99 Distribution

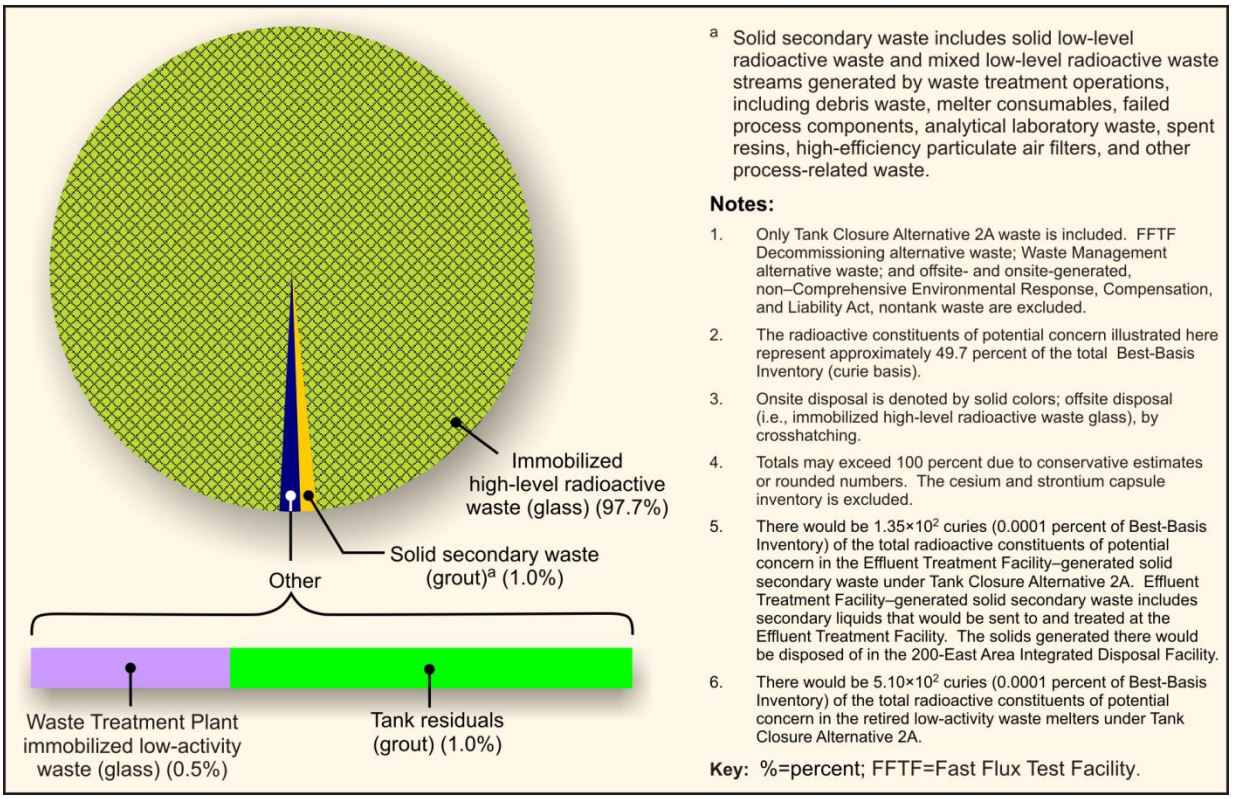
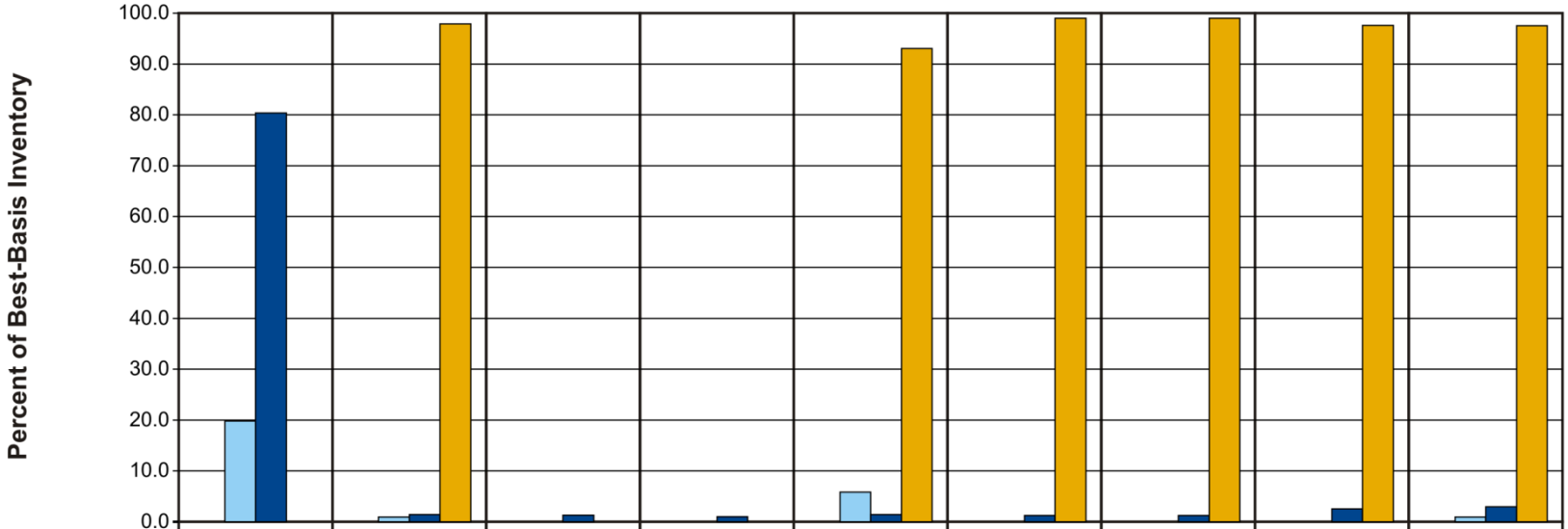


Figure D–18. Tank Closure Alternative 2A Distribution of Total Radioactive Constituents of Potential Concern



	Iodine-129	Cesium-137[a]	Carbon-14	Hydrogen-3 (Tritium)	Uranium-233, -234, -235,-238	Neptunium-237	Plutonium-239, -240	Strontium-90[a]	Technetium-99
Best-Basis Inventory (curies)	4.82×10^{1}	4.58×10^{7}	3.12×10^{3}	1.21×10^{4}	9.38×10^{2}	1.41×10^{2}	8.14×10^{4}	5.05×10^{7}	2.97×10^{4}
% disposal									
Onsite (glass)[b]	19.8	1.0	0.0	0.0	5.8	0.0	0.0	0.0	1.0
Onsite (grout)[c]	80.4	1.4	1.3	1.0	1.4	1.2	1.2	2.5	3.0
Offsite (glass)[d]	0.0	97.9	0.0	0.0	93.1	99.0	99.0	97.6	97.7
Total[e]	100.2	100.2	1.3	1.0	100.3	100.2	100.2	100.1	101.7

[a] This figure excludes the inventory and secondary waste generated by the treatment of the cesium and strontium capsules.
[b] Immobilized low-activity waste glass.
[c] Tank residuals, retired low-activity waste melters, solid secondary waste, and Effluent Treatment Facility–generated solid secondary waste.
[d] Immobilized high-level radioactive waste glass.
[e] Totals may exceed 100 percent due to conservative estimates or rounded numbers. Totals may not equal the sum of the contributions due to rounding. Carbon-14 and hydrogen-3 (tritium) may not total 100 percent because portions of each would be released to the offgas streams and stack(s) or to the State-Approved Land Disposal Site.

Note: Only Tank Closure Alternative 2B waste is included. FFTF Decommissioning alternative waste; Waste Management alternative waste; and offsite- and onsite-generated, non-Comprehensive Environmental Response, Compensation, and Liability Act, nontank waste are excluded
Key: %=percent; FFTF=Fast Flux Test Facility.

Figure D–19. Tank Closure Alternative 2B Distribution of Radioactive Constituents of Potential Concern

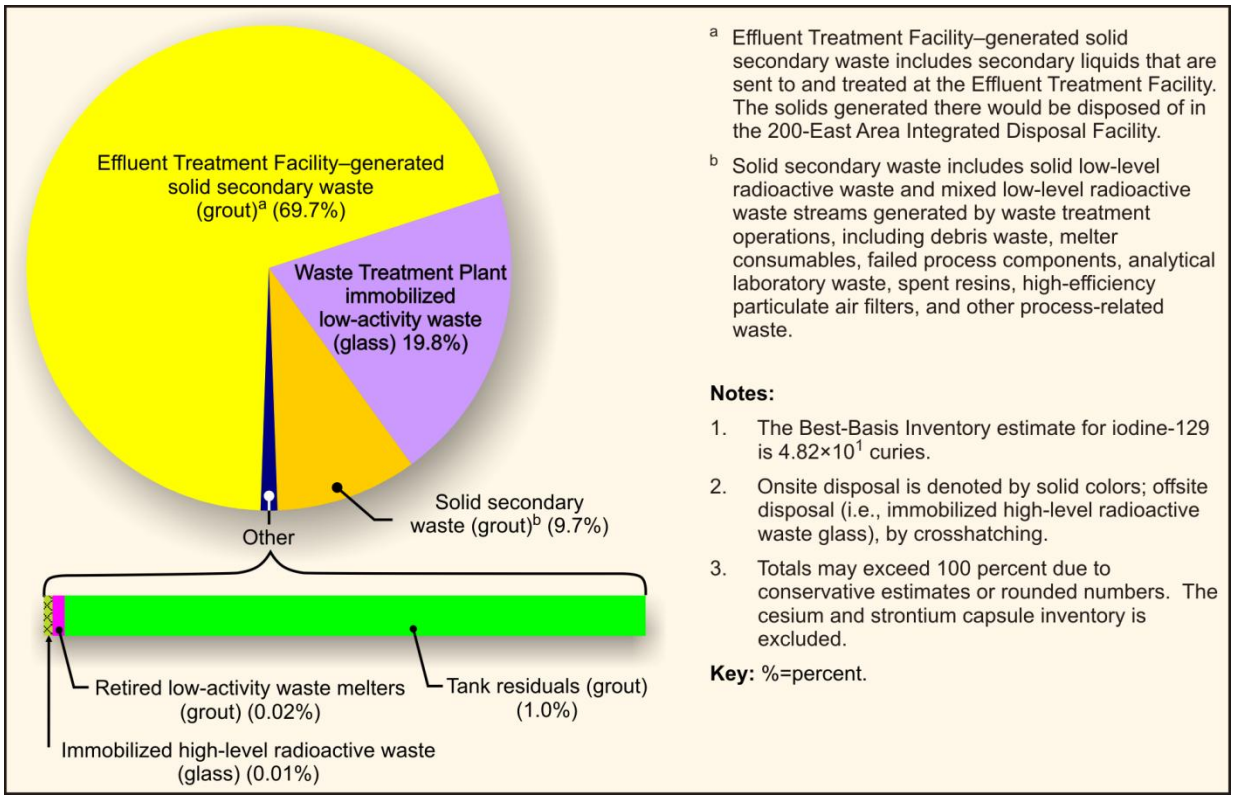


Figure D–20. Tank Closure Alternative 2B Iodine-129 Distribution

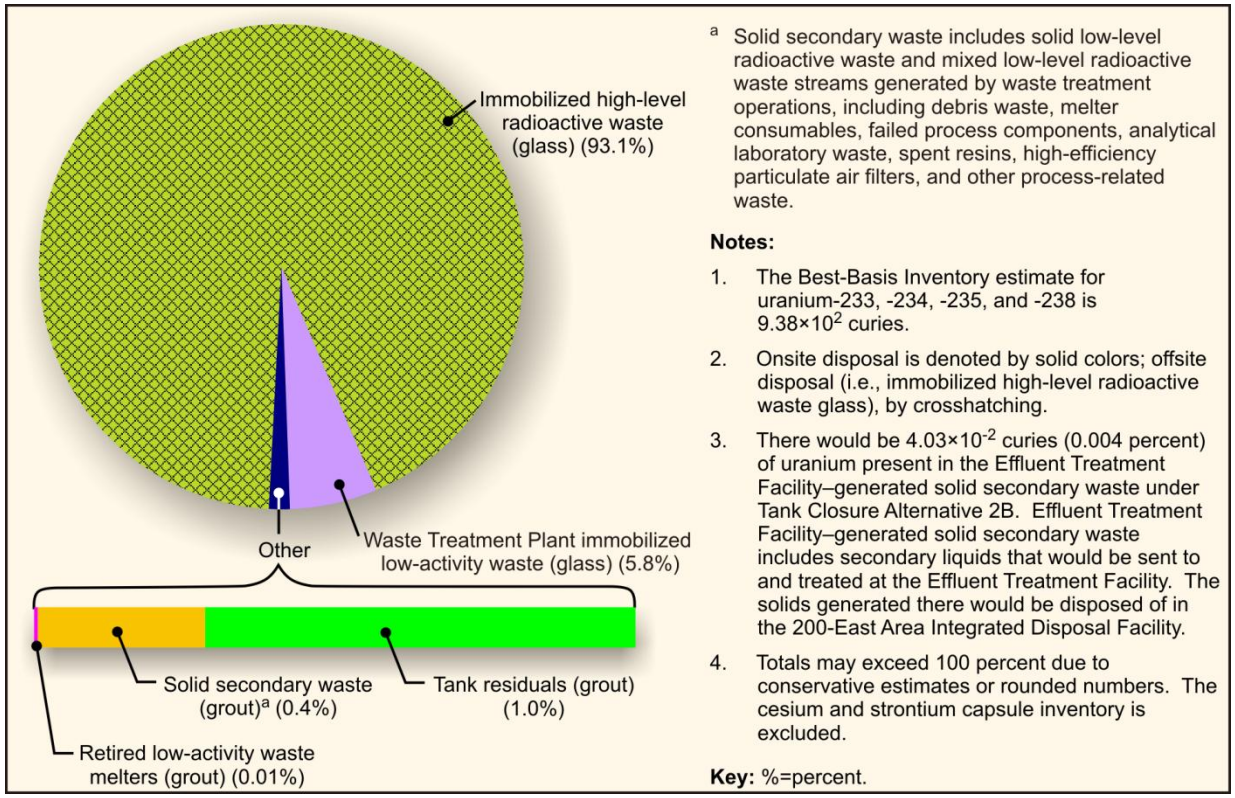


Figure D–21. Tank Closure Alternative 2B Uranium Distribution

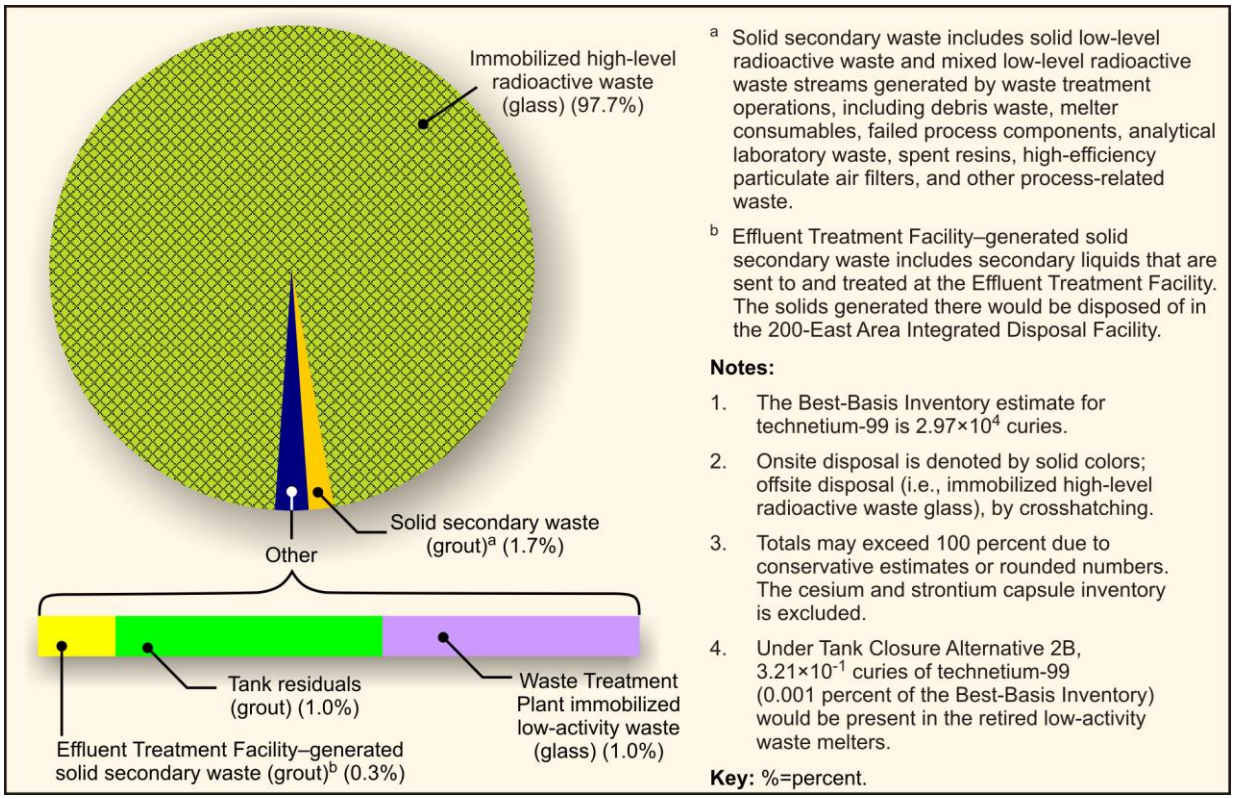


Figure D–22. Tank Closure Alternative 2B Technetium-99 Distribution

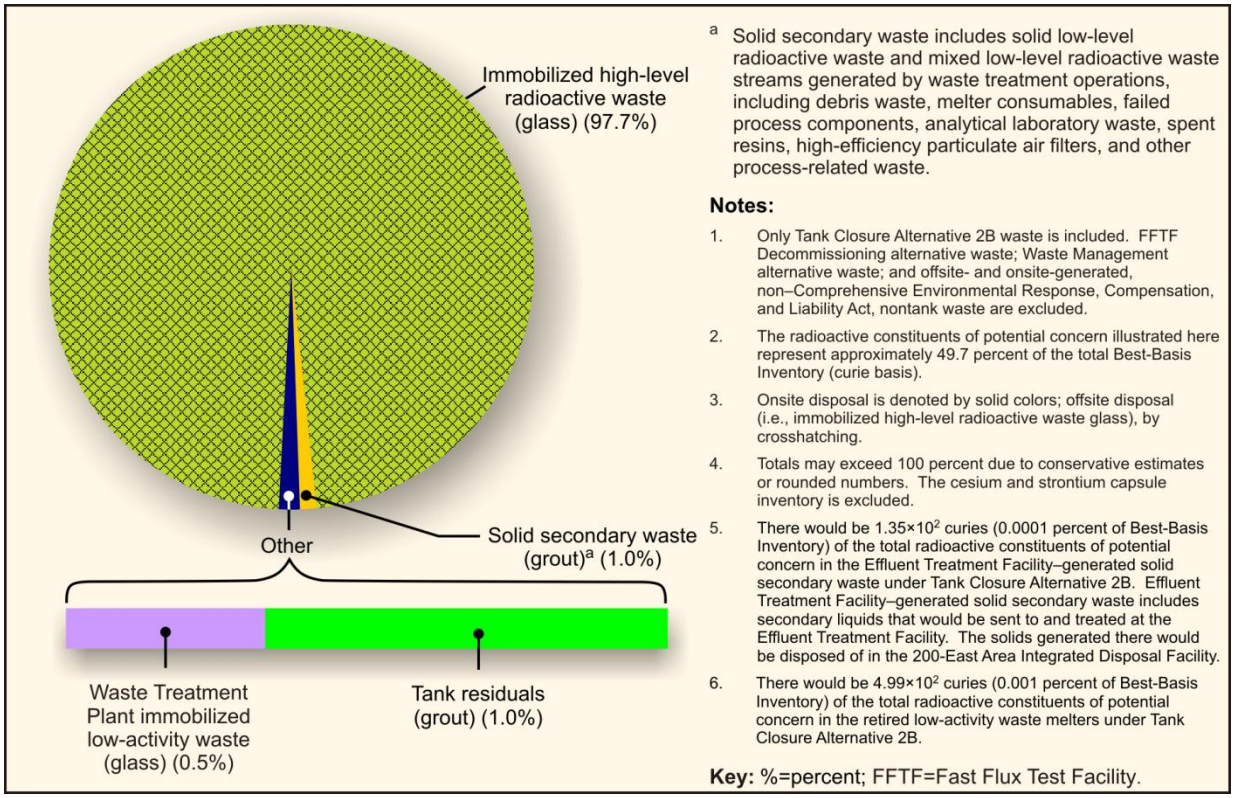
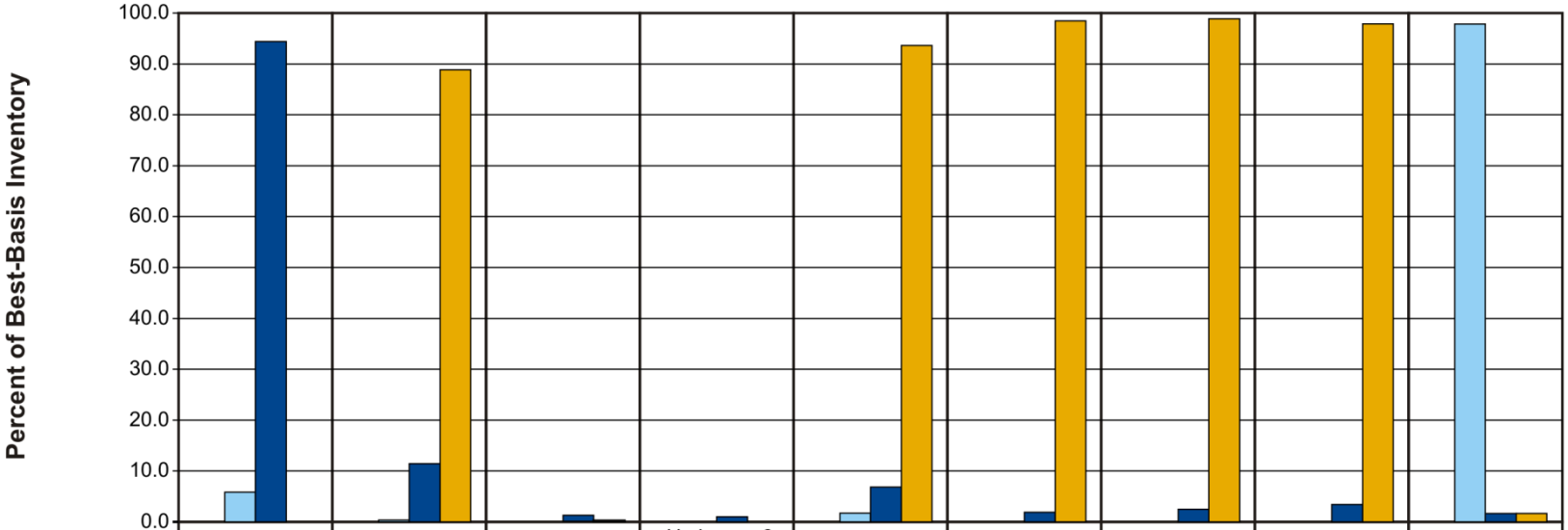


Figure D–23. Tank Closure Alternative 2B Distribution of Total Radioactive Constituents of Potential Concern



	Iodine-129	Cesium-137[a]	Carbon-14	Hydrogen-3 (Tritium)	Uranium-233, -234, -235, -238	Neptunium-237	Plutonium-239, -240	Strontium-90[a]	Technetium-99
Best-Basis Inventory (curies)	4.82×10^{1}	4.58×10^{7}	3.12×10^{3}	1.21×10^{4}	9.38×10^{2}	1.41×10^{2}	8.14×10^{4}	5.05×10^{7}	2.97×10^{4}
% disposal									
Onsite (glass)[b]	19.8	10.5	0.0	0.0	7.2	0.7	1.3	0.9	97.8
Onsite (grout)[c]	80.3	1.4	1.2	1.0	1.4	1.2	1.2	2.5	1.6
Offsite (glass)[d]	0.1	88.8	0.1	0.0	93.6	98.5	98.9	97.9	1.6
Total[e]	100.3	100.7	1.3	1.0	102.2	100.4	101.4	101.3	101.1

[a] This figure excludes the inventory and secondary waste generated by the treatment of the cesium and strontium capsules.
[b] Immobilized low-activity waste glass.
[c] Tank residuals, retired low-activity waste melters, solid secondary waste, and Effluent Treatment Facility–generated solid secondary waste.
[d] Immobilized high-level radioactive waste glass.
[e] Totals may exceed 100 percent due to conservative estimates or rounded numbers. Totals may not equal the sum of the contributions due to rounding. Carbon-14 and hydrogen-3 (tritium) may not total 100 percent because portions of each would be released to the offgas streams and stack(s) or to the State-Approved Land Disposal Site.

Note: Only Tank Closure Alternative 3A waste is included. FFTF Decommissioning alternative waste; Waste Management alternative waste; and offsite- and onsite-generated, non-CERCLA=Comprehensive Environmental Response, Compensation, and Liability Act, nontank waste are excluded.
Key: %=percent; FFTF=Fast Flux Test Facility.

Figure D–24. Tank Closure Alternative 3A Distribution of Radioactive Constituents of Potential Concern

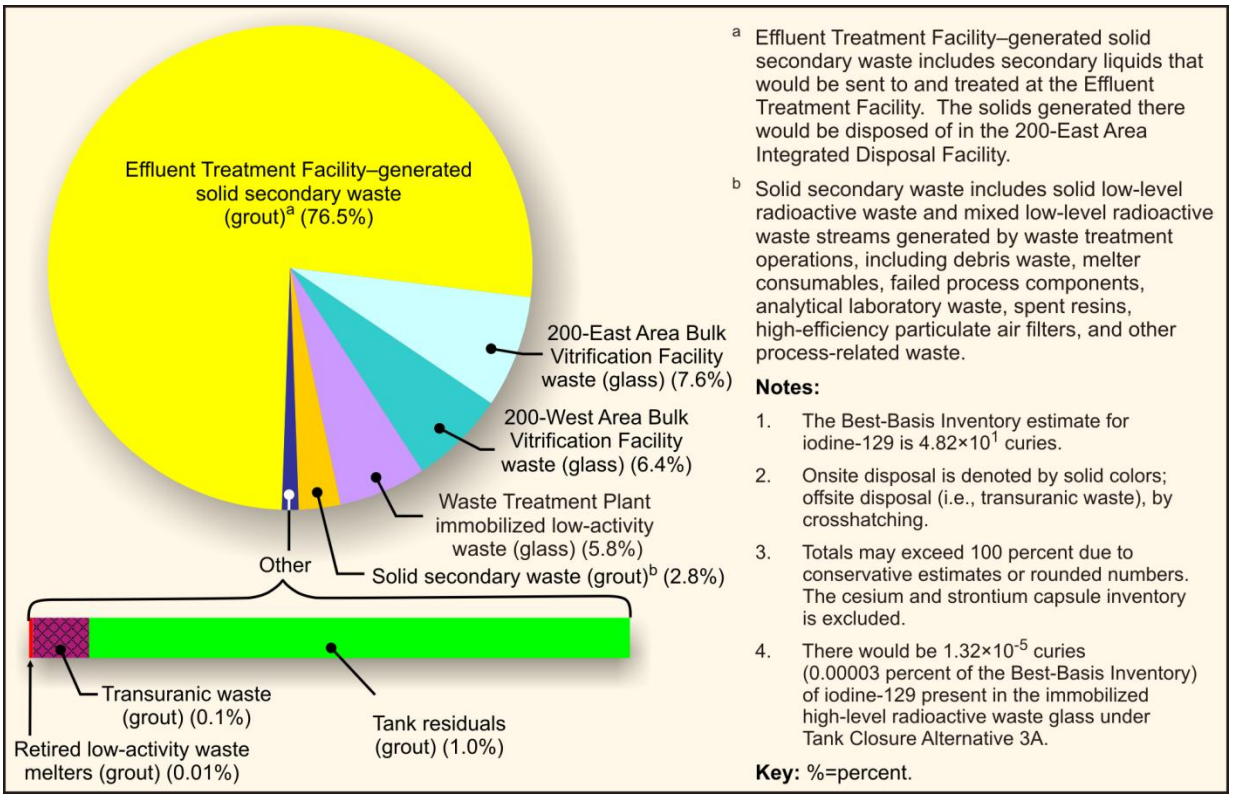


Figure D–25. Tank Closure Alternative 3A Iodine-129 Distribution

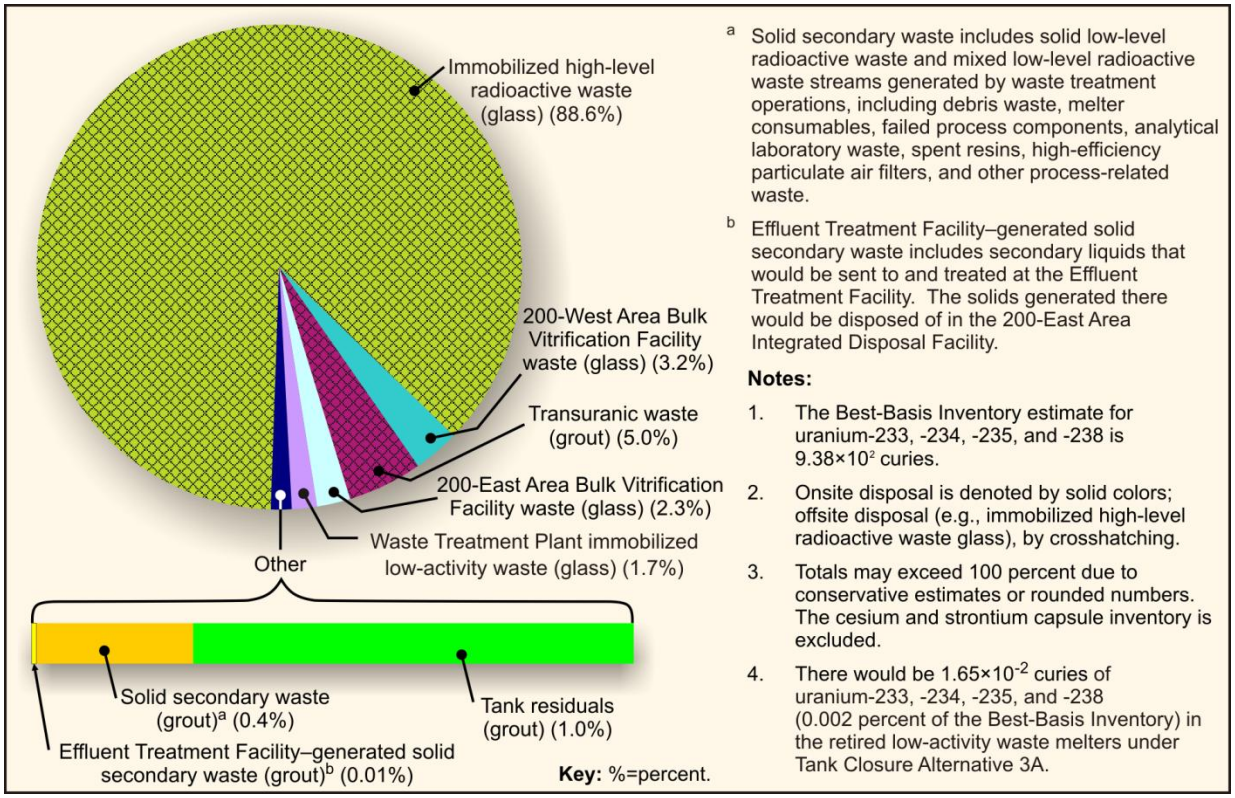


Figure D–26. Tank Closure Alternative 3A Uranium Distribution

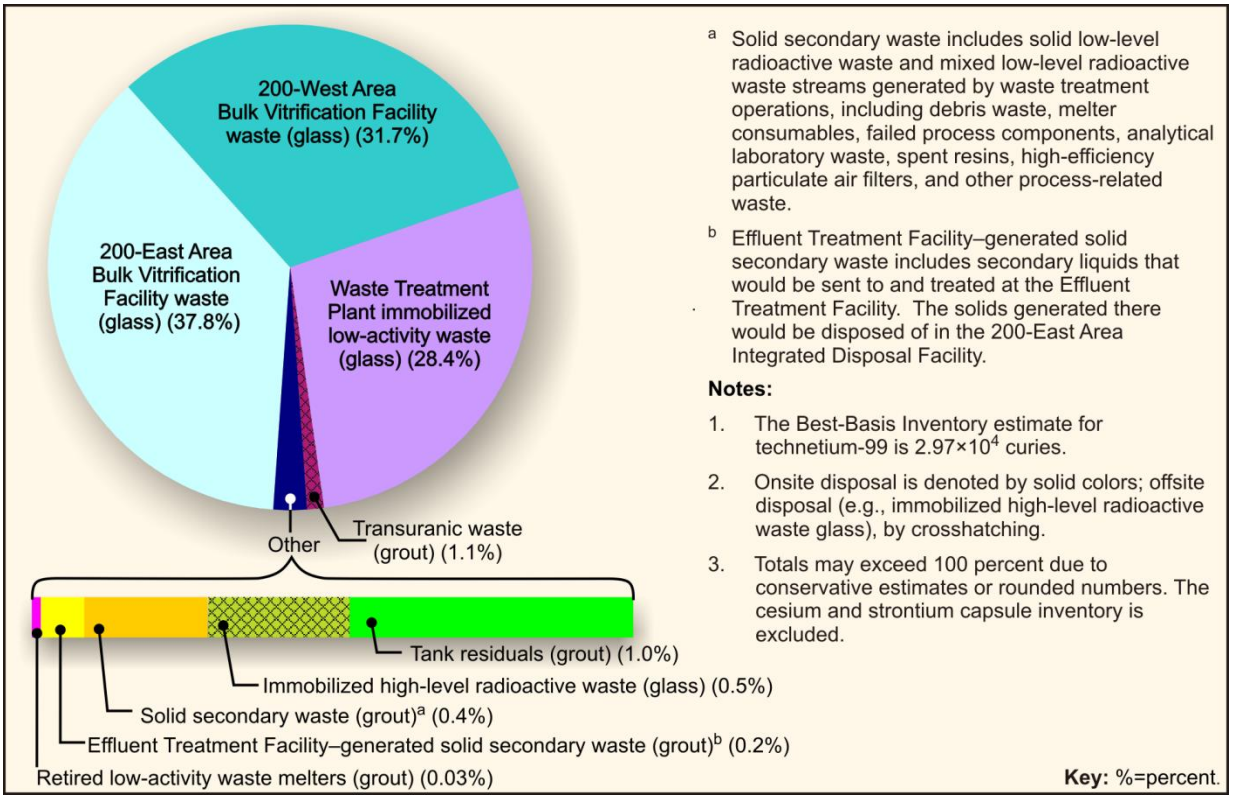


Figure D–27. Tank Closure Alternative 3A Technetium-99 Distribution

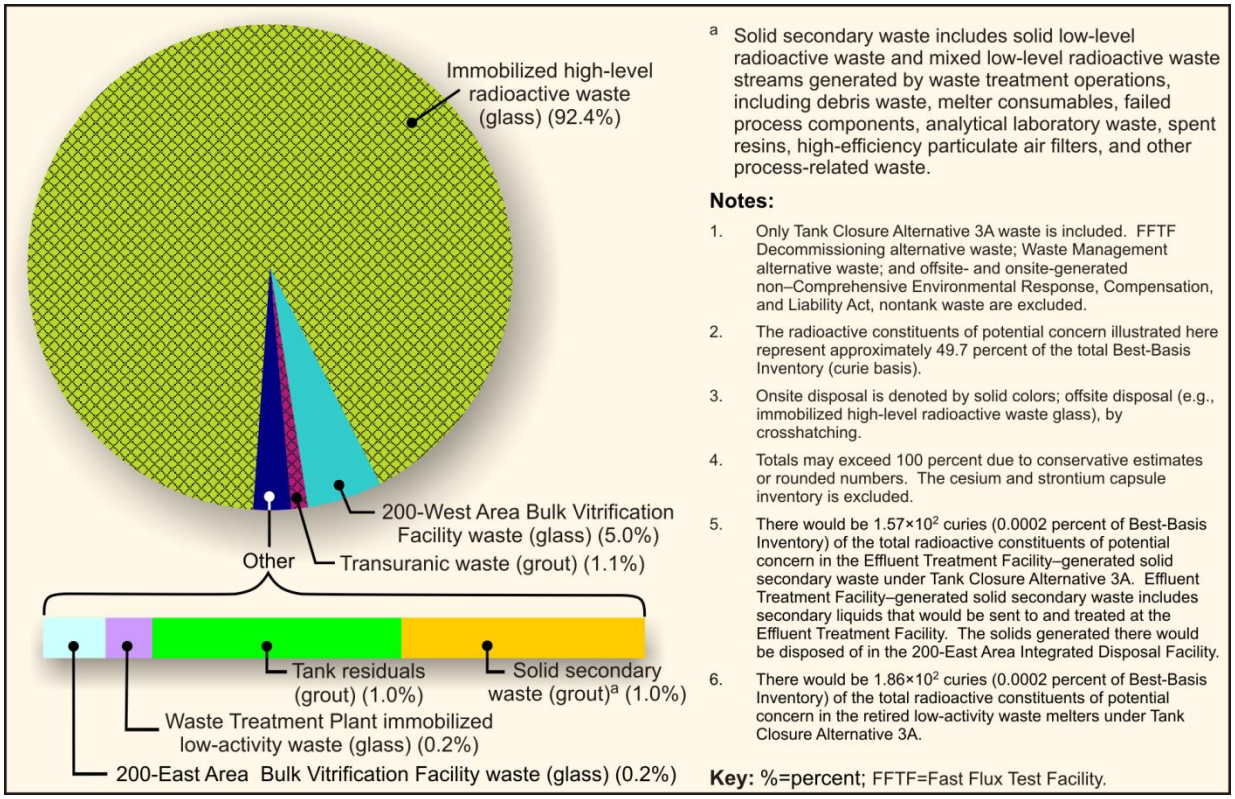
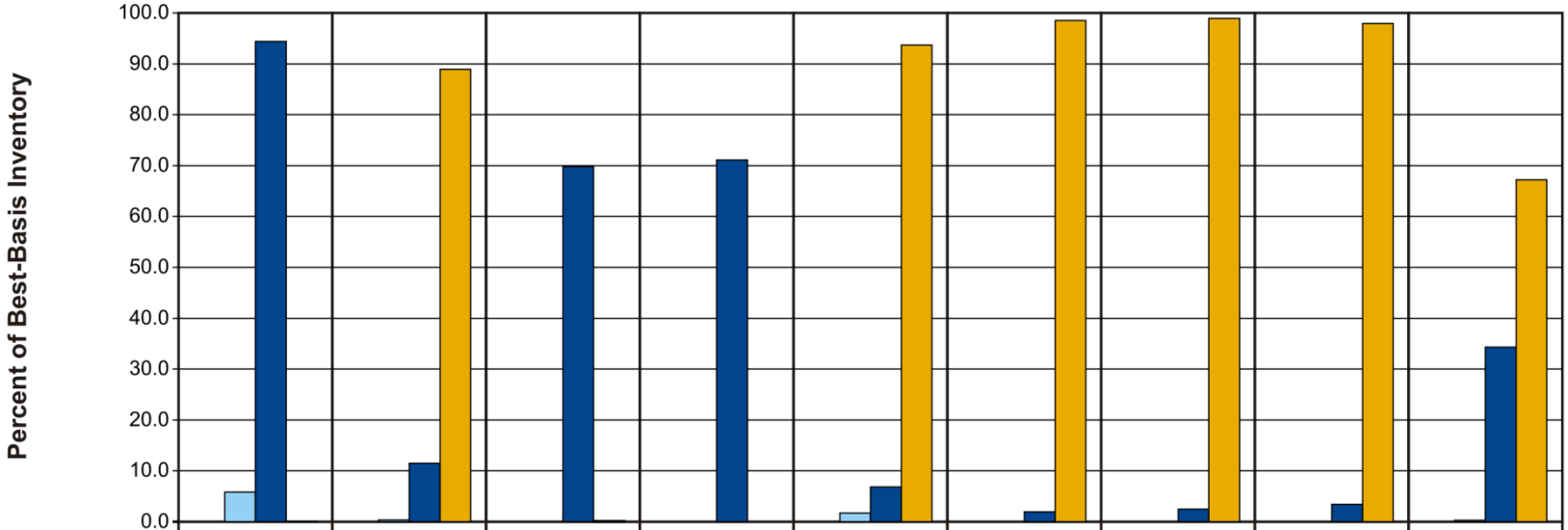


Figure D–28. Tank Closure Alternative 3A Distribution of Total Radioactive Constituents of Potential Concern



	Iodine-129	Cesium-137[a]	Carbon-14	Hydrogen-3 (Tritium)	Uranium-233, -234, -235, -238	Neptunium-237	Plutonium-239, -240	Strontium-90[a]	Technetium-99
Best-Basis Inventory (curies)	4.82×10^{1}	4.58×10^{7}	3.12×10^{3}	1.21×10^{4}	9.38×10^{2}	1.41×10^{2}	8.14×10^{4}	5.05×10^{7}	2.97×10^{4}
% disposal									
Onsite (glass)[b]	5.8	0.4	0.0	0.0	1.7	0.0	0.0	0.0	0.3
Onsite (grout)[c]	94.4	11.5	69.8	71.1	6.8	1.9	2.5	3.4	34.4
Offsite[d]	0.1	88.8	0.1	0.0	93.6	98.5	98.9	97.9	67.3
Total[e]	100.3	100.7	69.9	71.1	102.2	100.4	101.4	101.3	102.0

[a] This figure excludes the inventory and secondary waste generated by the treatment of the cesium and strontium capsules.
[b] Immobilized low-activity waste glass.
[c] Tank residuals, retired low-activity waste melters, solid secondary waste, and Effluent Treatment Facility–generated solid secondary waste.
[d] Immobilized high-level radioactive waste glass.
[e] Totals may exceed 100 percent due to conservative estimates or rounded numbers. Totals may not equal the sum of the contributions due to rounding. Carbon-14 and hydrogen-3 (tritium) may not total 100 percent because portions of each would be released to the offgas streams and stack(s) or to the State-Approved Land Disposal Site.

Note: Only Tank Closure Alternative 3B waste is included. FFTF Decommissioning alternative waste; Waste Management alternative waste; and offsite- and onsite-generated, non-Comprehensive Environmental Response, Compensation, and Liability Act, nontank waste are excluded.
Key: %=percent; FFTF=Fast Flux Test Facility.

Figure D–29. Tank Closure Alternative 3B Distribution of Radioactive Constituents of Potential Concern

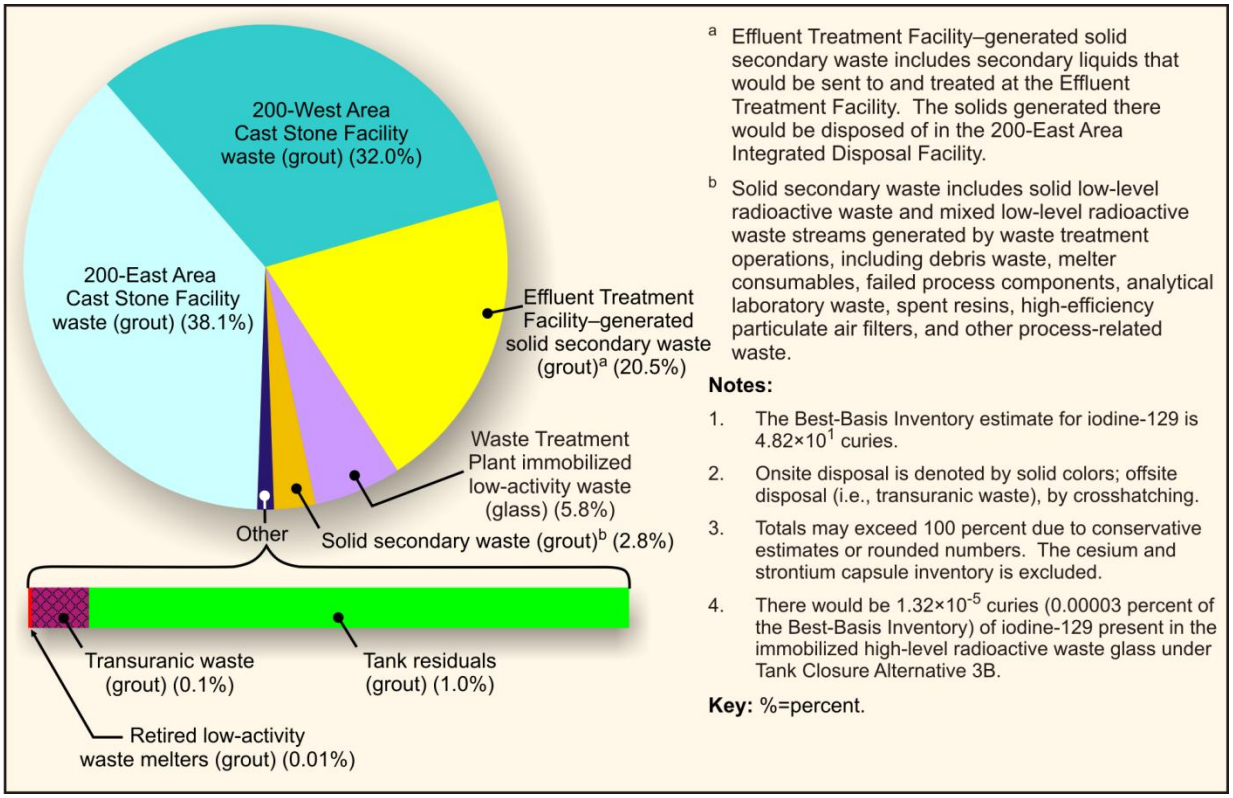


Figure D–30. Tank Closure Alternative 3B Iodine-129 Distribution

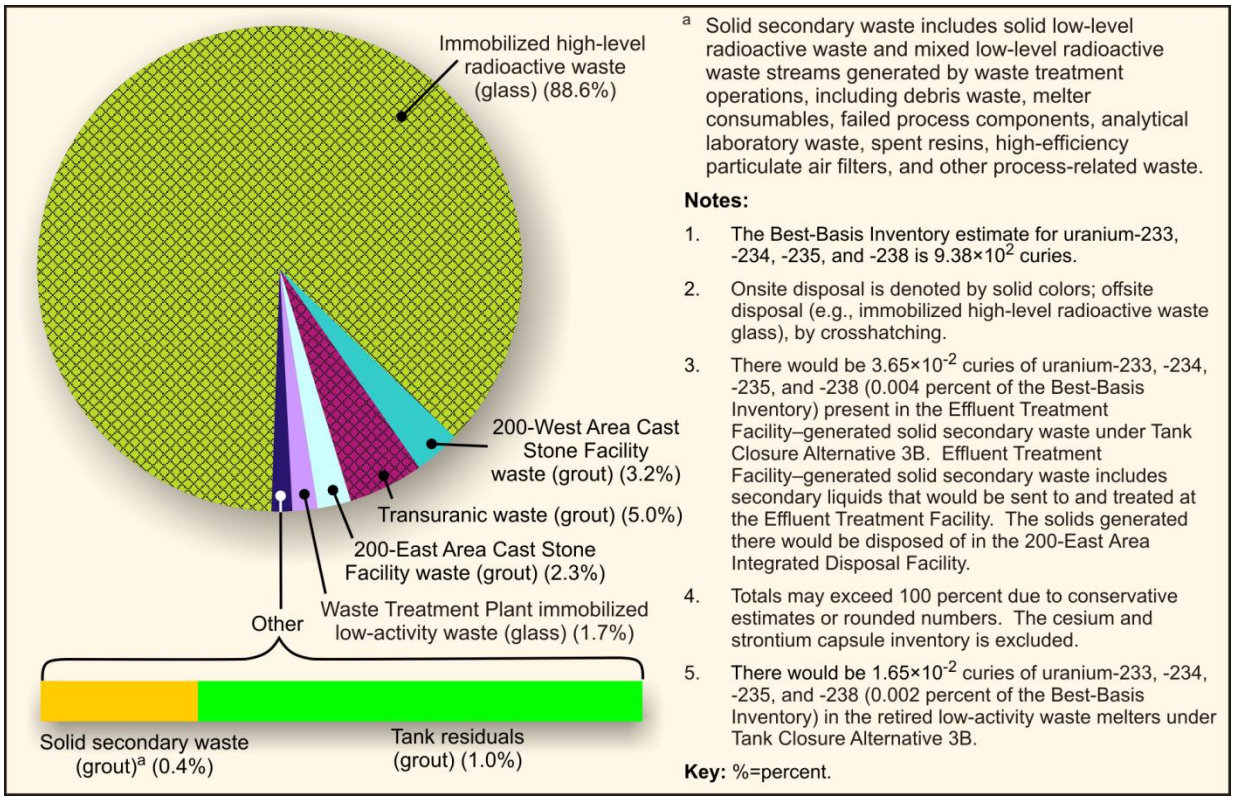


Figure D–31. Tank Closure Alternative 3B Uranium Distribution

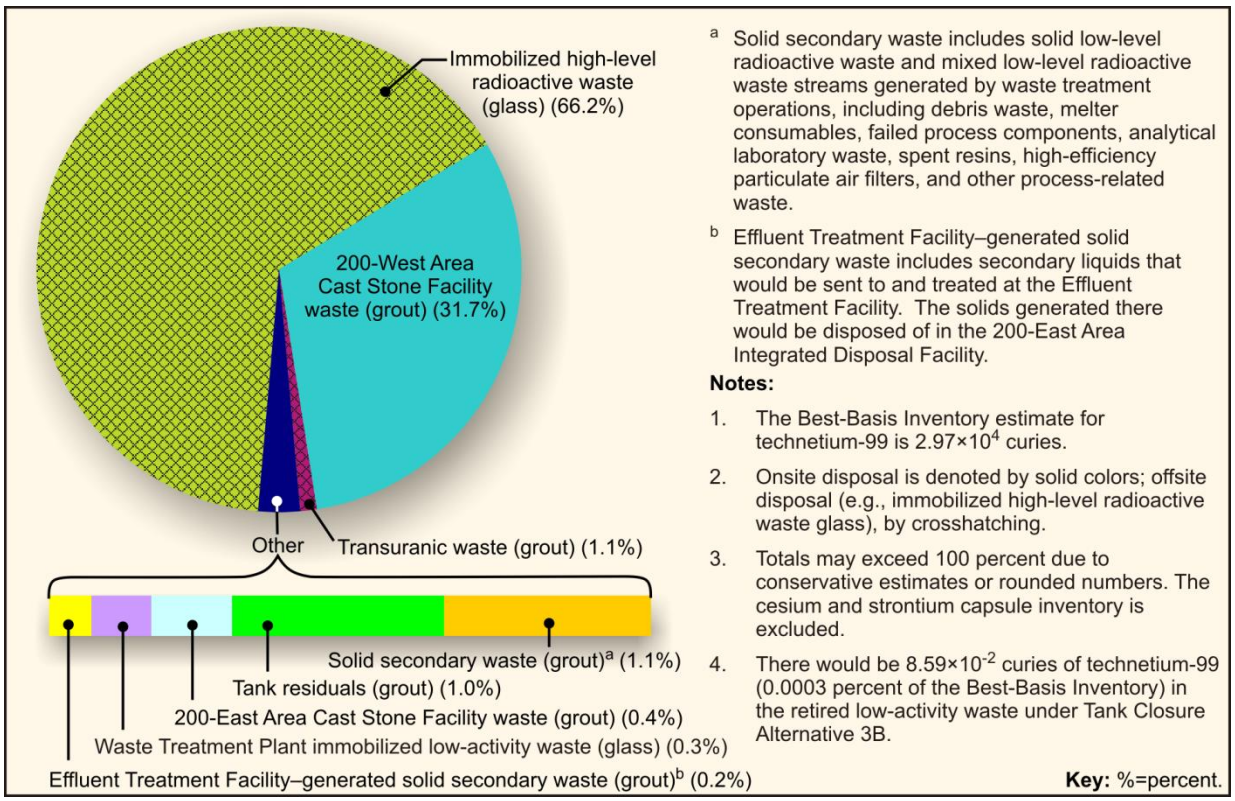


Figure D–32. Tank Closure Alternative 3B Technetium-99 Distribution

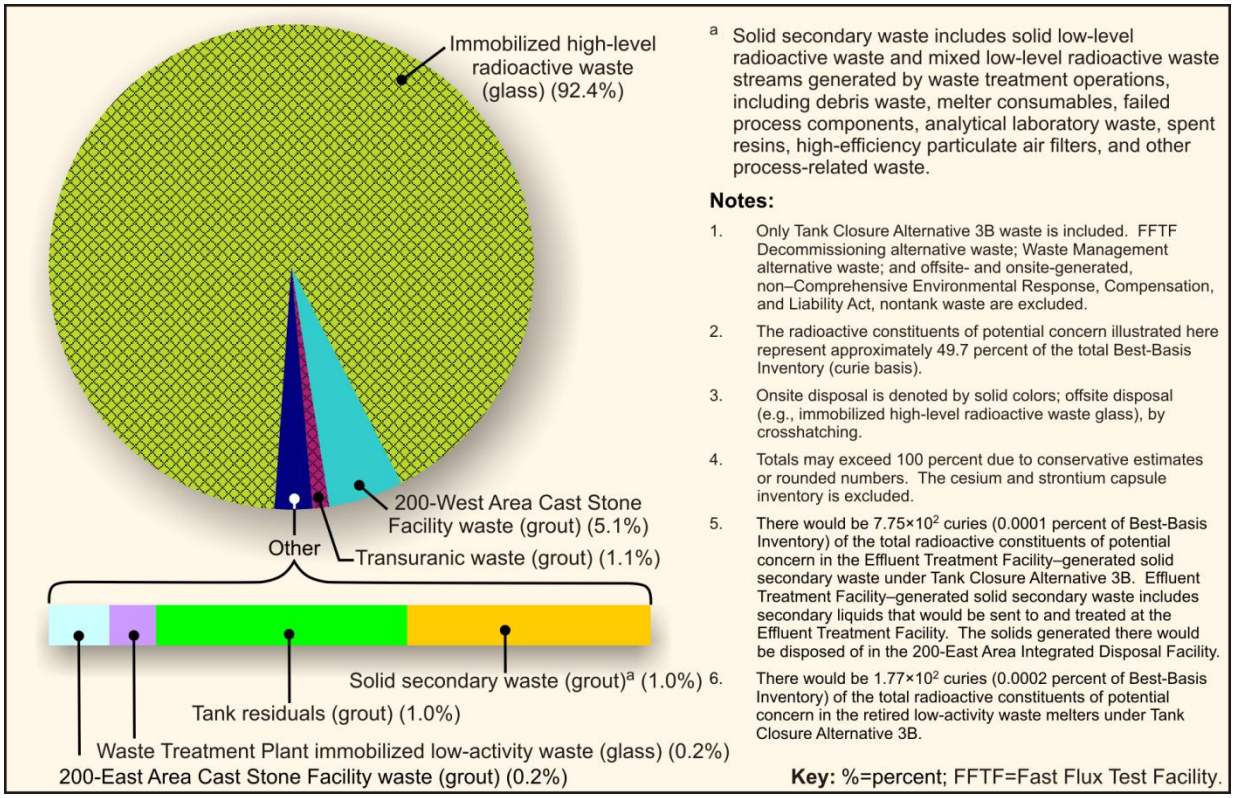
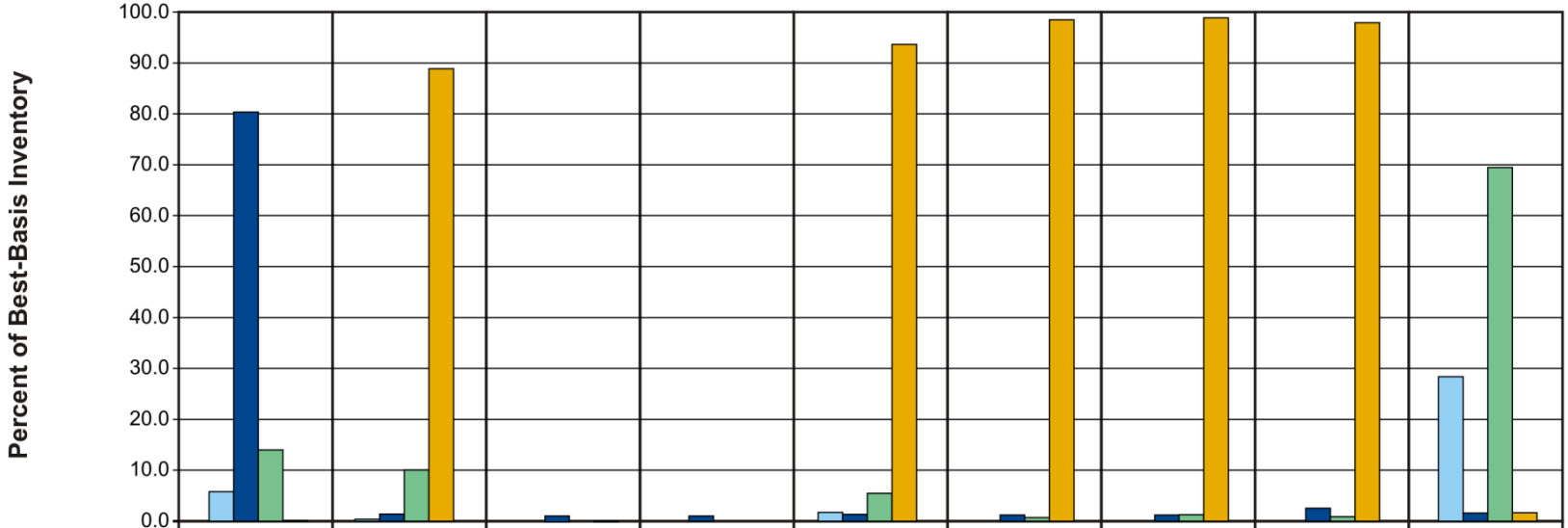


Figure D–33. Tank Closure 3B Distribution of Total Radioactive Constituents of Potential Concern



	Iodine-129	Cesium-137[a]	Carbon-14	Hydrogen-3 (Tritium)	Uranium-233, -234, -235, -238	Neptunium-237	Plutonium-239, -240	Strontium-90[a]	Technetium-99
Best-Basis Inventory (curies)	4.82×10^{1}	4.58×10^{7}	3.12×10^{3}	1.21×10^{4}	9.38×10^{2}	1.41×10^{2}	8.14×10^{4}	5.05×10^{7}	2.97×10^{4}
% disposal									
Onsite (glass)[b]	5.8	0.4	0.0	0.0	1.7	0.0	0.0	0.0	28.4
Onsite (grout)[c]	80.3	1.4	1.2	1.0	1.4	1.2	1.2	2.5	1.6
Onsite (steam reforming waste)	14.0	10.1	0.0	0.0	5.5	0.7	1.3	0.9	69.5
Offsite[d]	0.1	88.8	0.1	0.0	93.6	98.5	98.9	97.9	1.6
Total[e]	100.3	100.7	1.3	1.0	102.2	100.4	101.4	101.3	101.1

[a] This figure excludes the inventory and secondary waste generated by the treatment of the cesium and strontium capsules.
[b] Immobilized low-activity waste glass.
[c] Tank residuals, retired low-activity waste melters, solid secondary waste, and Effluent Treatment Facility–generated solid secondary waste.
[d] Immobilized high-level radioactive waste glass.
[e] Totals may exceed 100 percent due to conservative estimates or rounded numbers. Totals may not equal the sum of the contributions due to rounding. Carbon-14 and hydrogen-3 (tritium) may not total 100 percent because portions of each would be released to the offgas streams and stack(s) or to the State-Approved Land Disposal Site.

Note: Only Tank Closure Alternative 3C waste is included. FFTF Decommissioning alternative waste; Waste Management alternative waste; and offsite- and onsite-generated, non-Comprehensive Environmental Response, Compensation, and Liability Act, nontank waste are excluded.
Key: %=percent; FFTF=Fast Flux Test Facility.

Figure D–34. Tank Closure Alternative 3C Distribution of Radioactive Constituents of Potential Concern

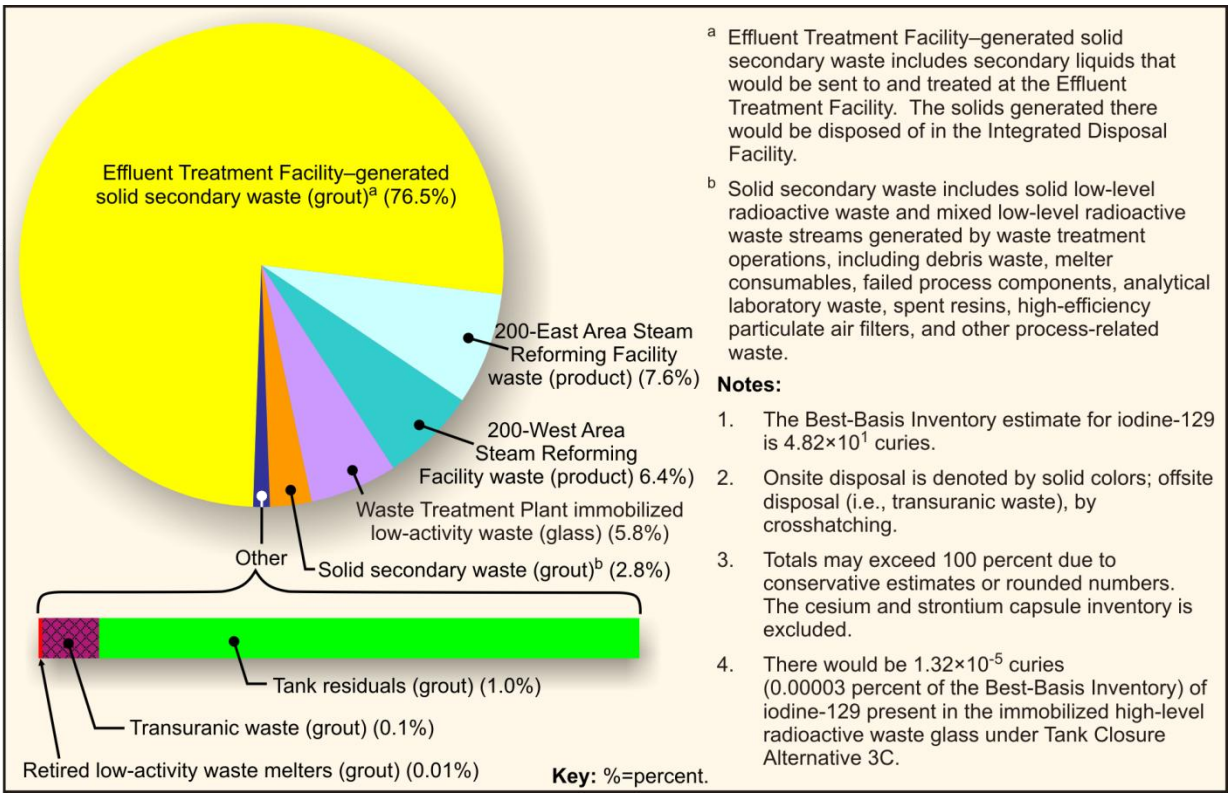


Figure D–35. Tank Closure Alternative 3C Iodine-129 Distribution

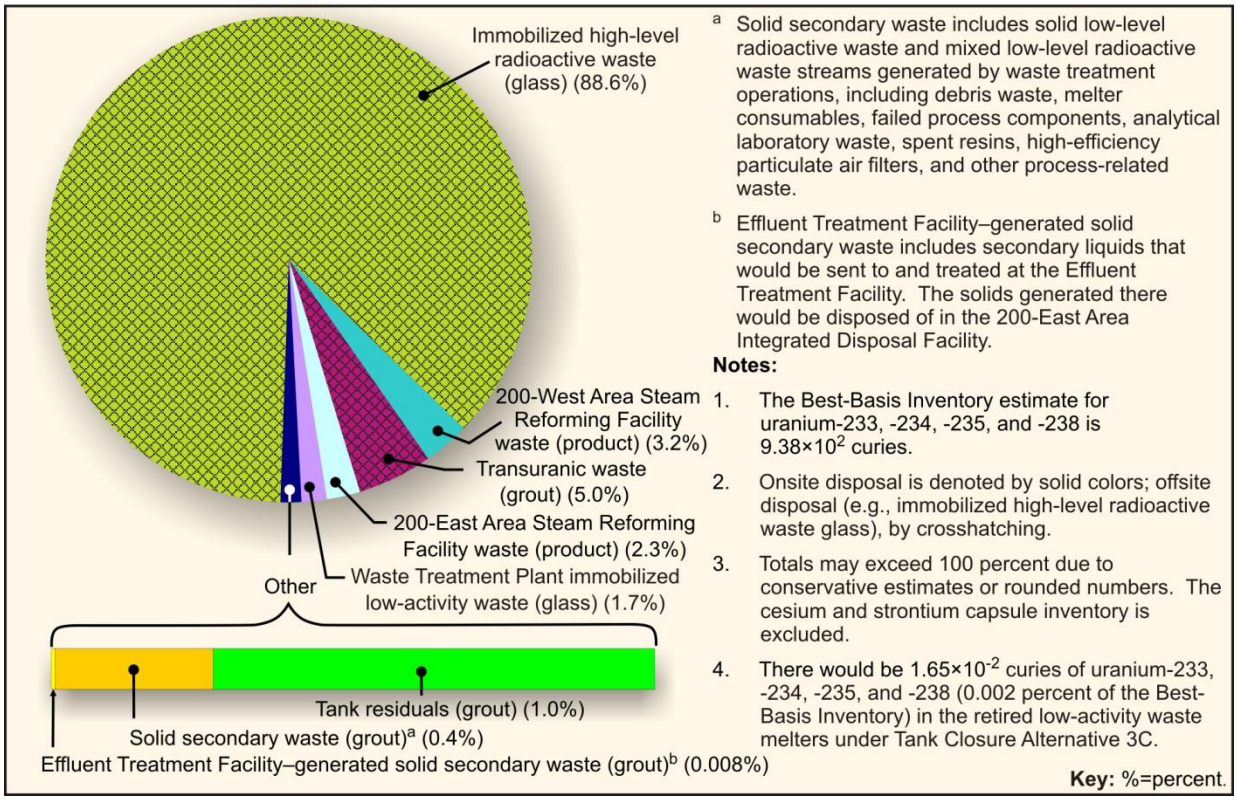


Figure D–36. Tank Closure Alternative 3C Uranium Distribution

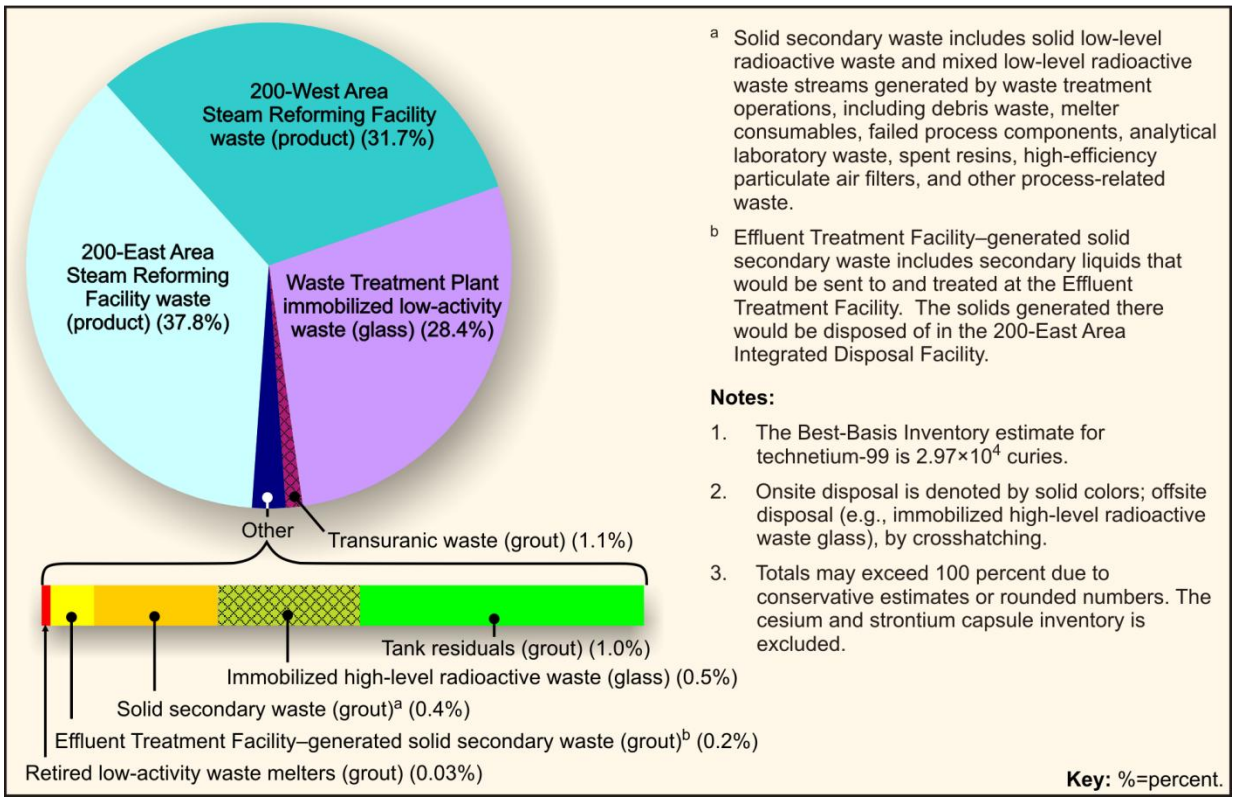


Figure D–37. Tank Closure Alternative 3C Technetium-99 Distribution

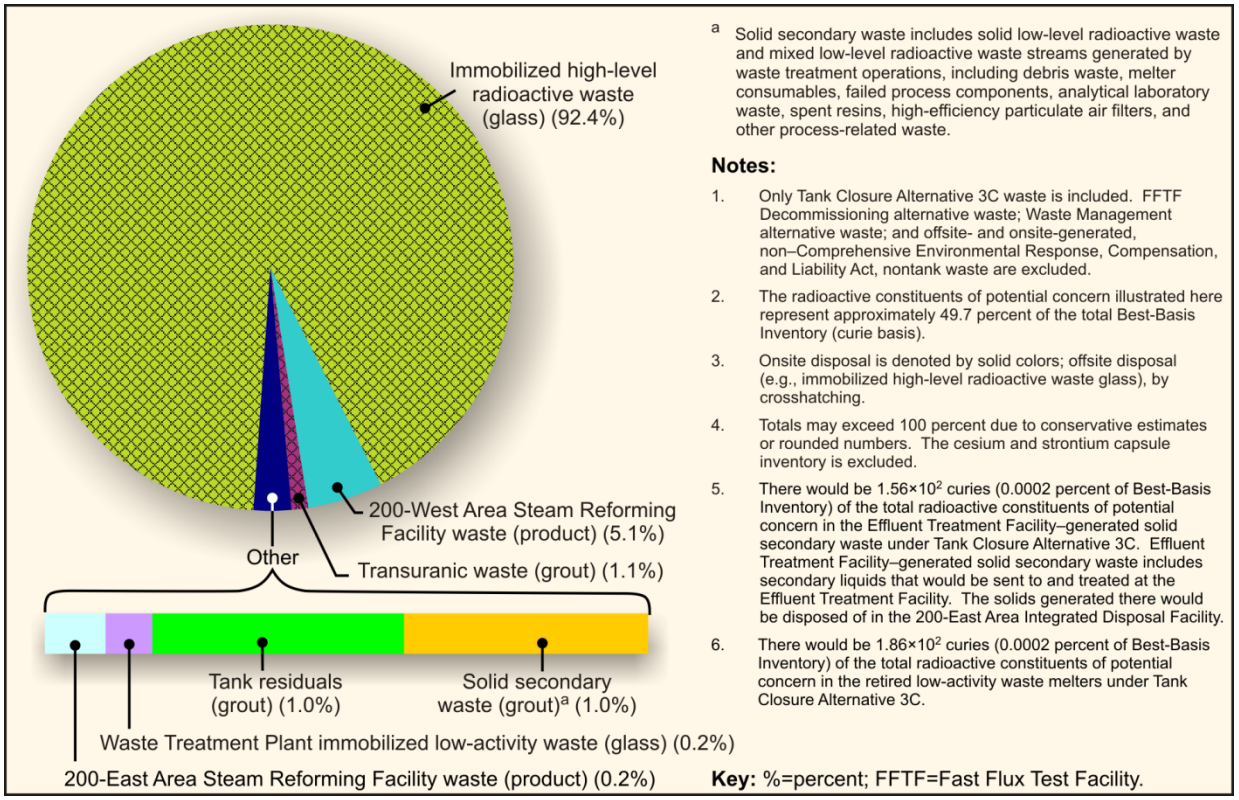
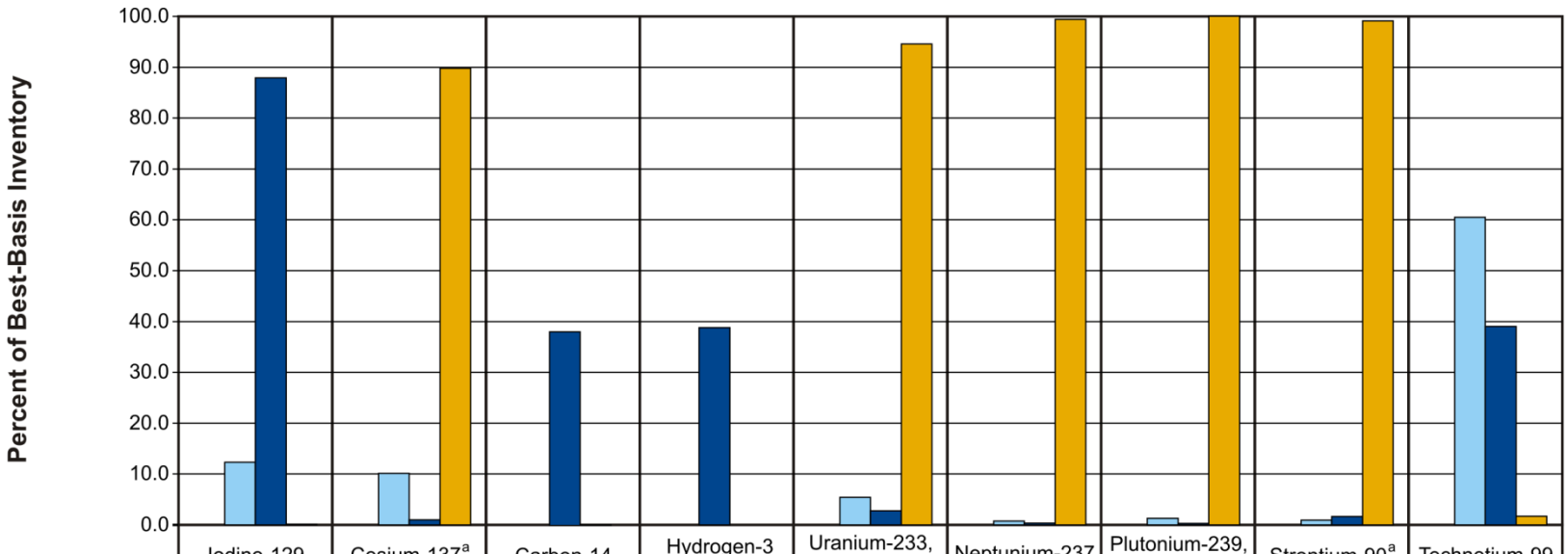


Figure D–38. Tank Closure Alternative 3C Distribution of Total Radioactive Constituents of Potential Concern



	Iodine-129	Cesium-137[a]	Carbon-14	Hydrogen-3 (Tritium)	Uranium-233, -234, -235, -238	Neptunium-237	Plutonium-239, -240	Strontium-90[a]	Technetium-99
Best-Basis Inventory (curies)	4.82×10^{1}	4.58×10^{7}	3.12×10^{3}	1.21×10^{4}	9.38×10^{2}	1.41×10^{2}	8.14×10^{4}	5.05×10^{7}	2.97×10^{4}
% disposal									
Onsite (glass)[b]	12.3	10.1	0.0	0.0	5.4	0.8	1.3	0.9	60.5
Onsite (grout)[c]	88.0	1.0	38.1	38.8	2.8	0.3	0.3	1.6	39.1
Offsite[d]	0.1	89.8	0.1	0.0	94.6	99.4	100.1	99.1	1.7
Total[e]	100.4	100.9	38.2	38.8	102.7	100.5	101.7	101.7	101.2

[a] This figure excludes the inventory and secondary waste generated by the treatment of the cesium and strontium capsules.
[b] Immobilized low-activity waste glass.
[c] Tank residuals, retired low-activity waste melters, solid secondary waste, and Effluent Treatment Facility–generated solid secondary waste.
[d] Immobilized high-level radioactive waste glass.
[e] Totals may exceed 100 percent due to conservative estimates or rounded numbers. Totals may not equal the sum of the contributions due to rounding. Carbon-14 and hydrogen-3 (tritium) may not total 100 percent because portions of each would be released to the offgas streams and stack(s) or to the State-Approved Land Disposal Site.

Note: Only Tank Closure Alternative 4 waste is included. FFTF Decommissioning alternative waste; Waste Management alternative waste; offsite- and onsite-generated, non-Comprehensive Environmental Response, Compensation, and Liability Act, nontank waste; inventories disposed of in the River Protection Project Disposal Facility; and Preprocessing Facility contributions (clean closure of BX and SX tank farms) to immobilized high-level radioactive waste and immobilized low-activity waste are excluded.
Key: %=percent; FFTF=Fast Flux Test Facility.

Figure D–39. Tank Closure Alternative 4 Distribution of Radioactive Constituents of Potential Concern

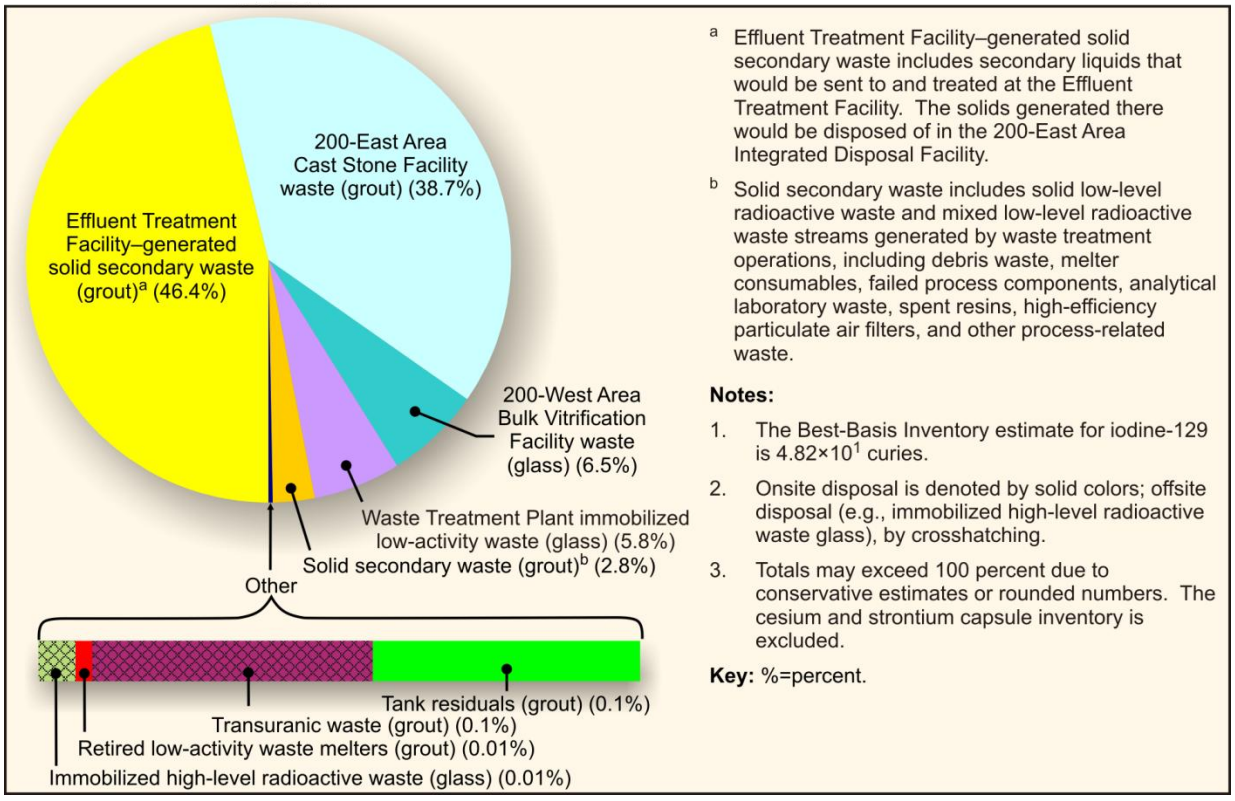


Figure D–40. Tank Closure Alternative 4 Iodine-129 Distribution

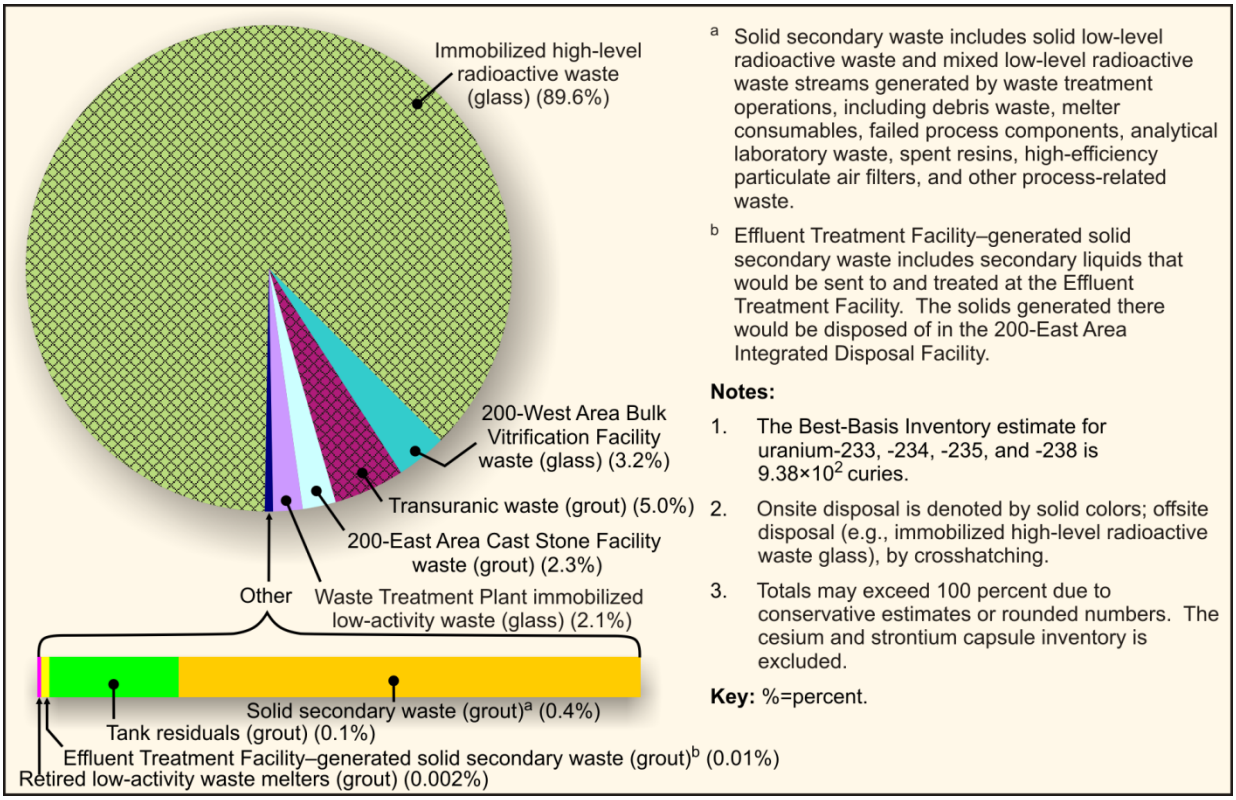


Figure D–41. Tank Closure Alternative 4 Uranium Distribution

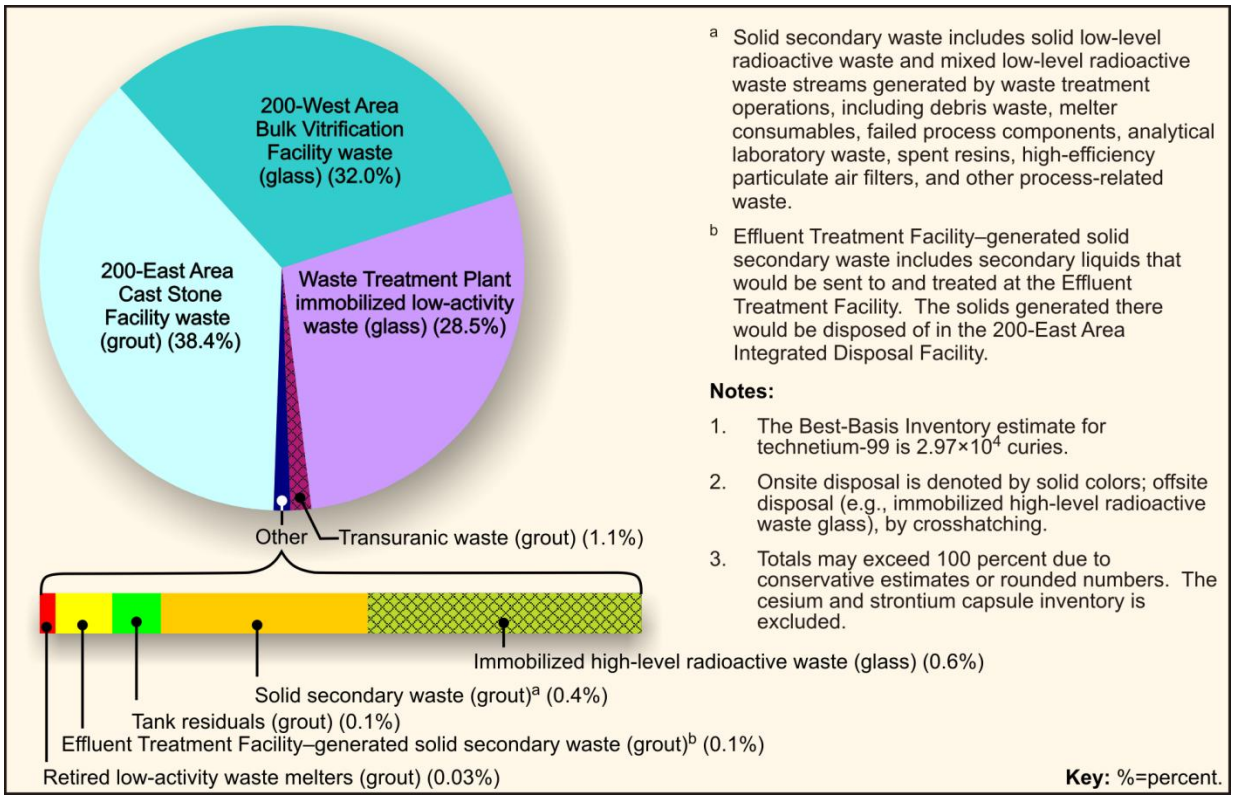


Figure D–42. Tank Closure Alternative 4 Technetium-99 Distribution

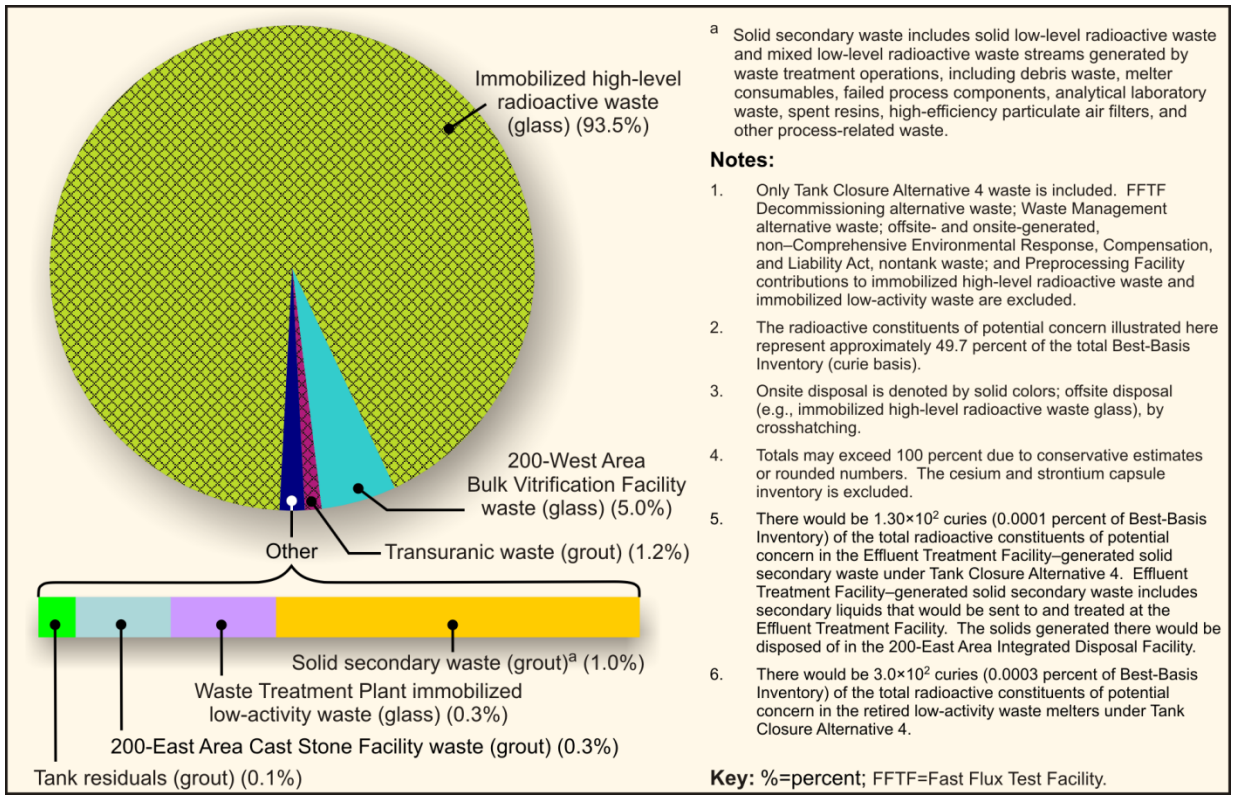
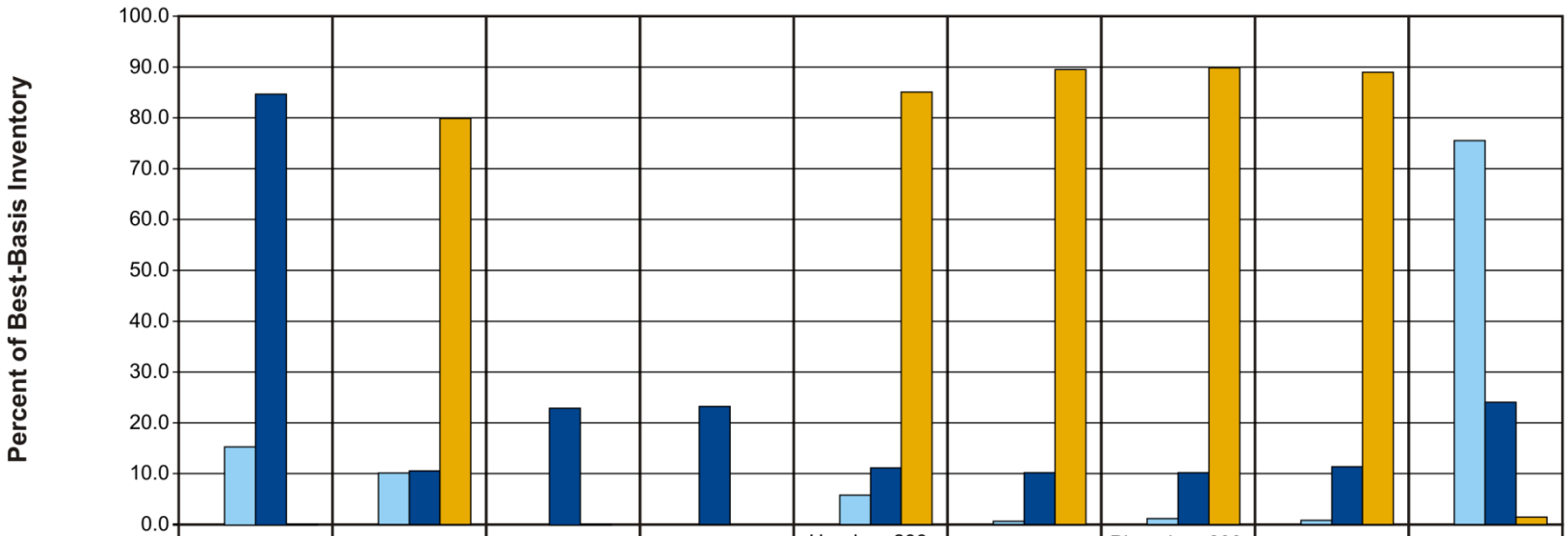


Figure D–43. Tank Closure Alternative 4 Distribution of Total Radioactive Constituents of Potential Concern



	Iodine-129	Cesium-137[a]	Carbon-14	Hydrogen-3 (Tritium)	Uranium-233, -234, -235, -238	Neptunium-237	Plutonium-239, -240	Strontium-90[a]	Technetium-99
Best-Basis Inventory (curies)	4.82×10^{1}	4.58×10^{7}	3.12×10^{3}	1.21×10^{4}	9.38×10^{2}	1.41×10^{2}	8.14×10^{4}	5.05×10^{7}	2.97×10^{4}
% disposal									
Onsite (glass)[b]	15.4	10.1	0.0	0.0	5.8	0.6	1.2	0.8	75.5
Onsite (grout)[c]	84.8	10.6	23.0	23.2	11.1	10.2	10.2	11.4	24.1
Offsite[d]	0.1	79.9	0.1	0.0	85.1	89.5	89.9	89.0	1.5
Total[e]	100.3	100.6	23.1	23.3	102.0	100.4	101.2	101.2	101.1

[a] This figure excludes the inventory and secondary waste generated by the treatment of the cesium and strontium capsules.
[b] Immobilized low-activity waste glass.
[c] Tank residuals, retired low-activity waste melters, solid secondary waste, and Effluent Treatment Facility–generated solid secondary waste.
[d] Immobilized high-level radioactive waste glass.
[e] Totals may exceed 100 percent due to conservative estimates or rounded numbers. Totals may not equal the sum of the contributions due to rounding. Carbon-14 and hydrogen-3 (tritium) may not total 100 percent because portions of each would be released to the offgas streams and stack(s) or to the State-Approved Land Disposal Site.

Note: Only Tank Closure Alternative 5 waste is included. FFTF Decommissioning alternative waste; Waste Management alternative waste; and offsite- and onsite-generated, non-Comprehensive Environmental Response, Compensation, and Liability Act, nontank waste are excluded.
Key: %=percent; FFTF=Fast Flux Test Facility.

Figure D–44. Tank Closure Alternative 5 Distribution of Radioactive Constituents of Potential Concern

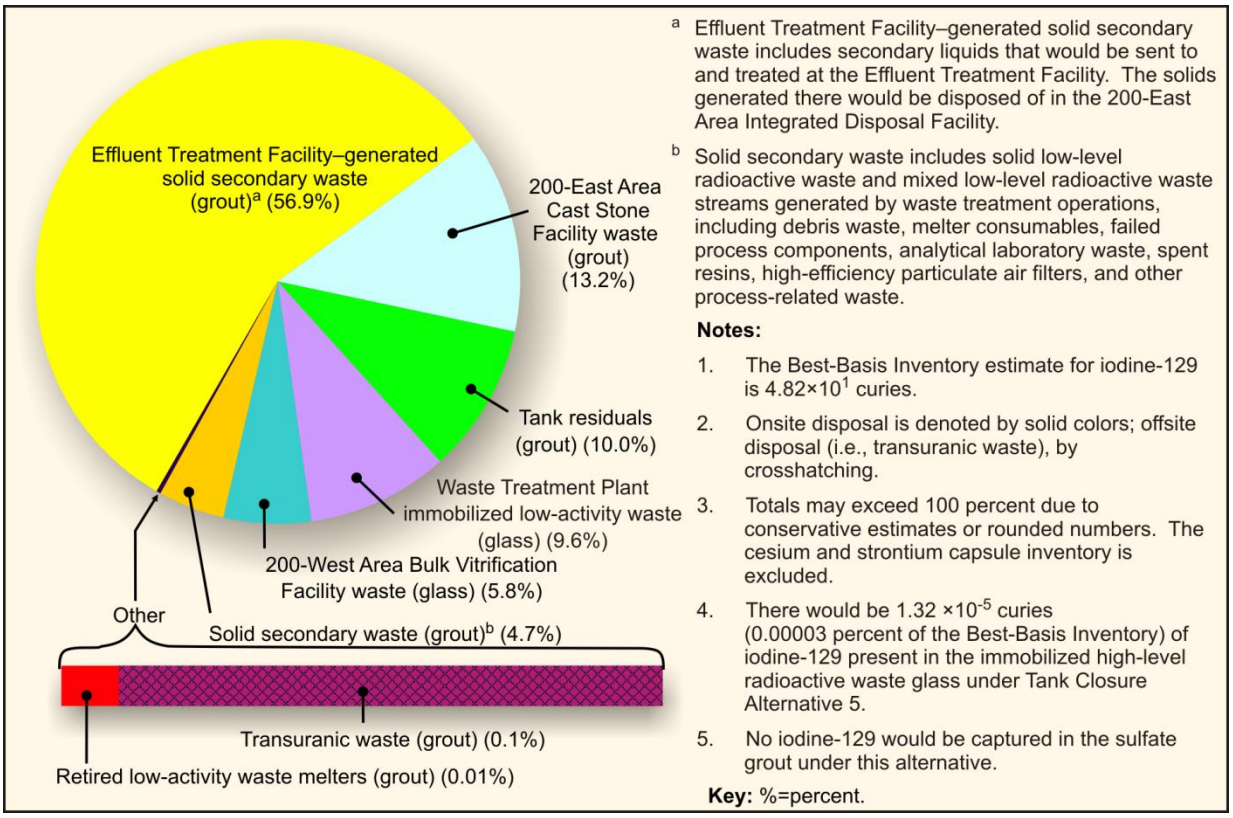


Figure D–45. Tank Closure Alternative 5 Iodine-129 Distribution

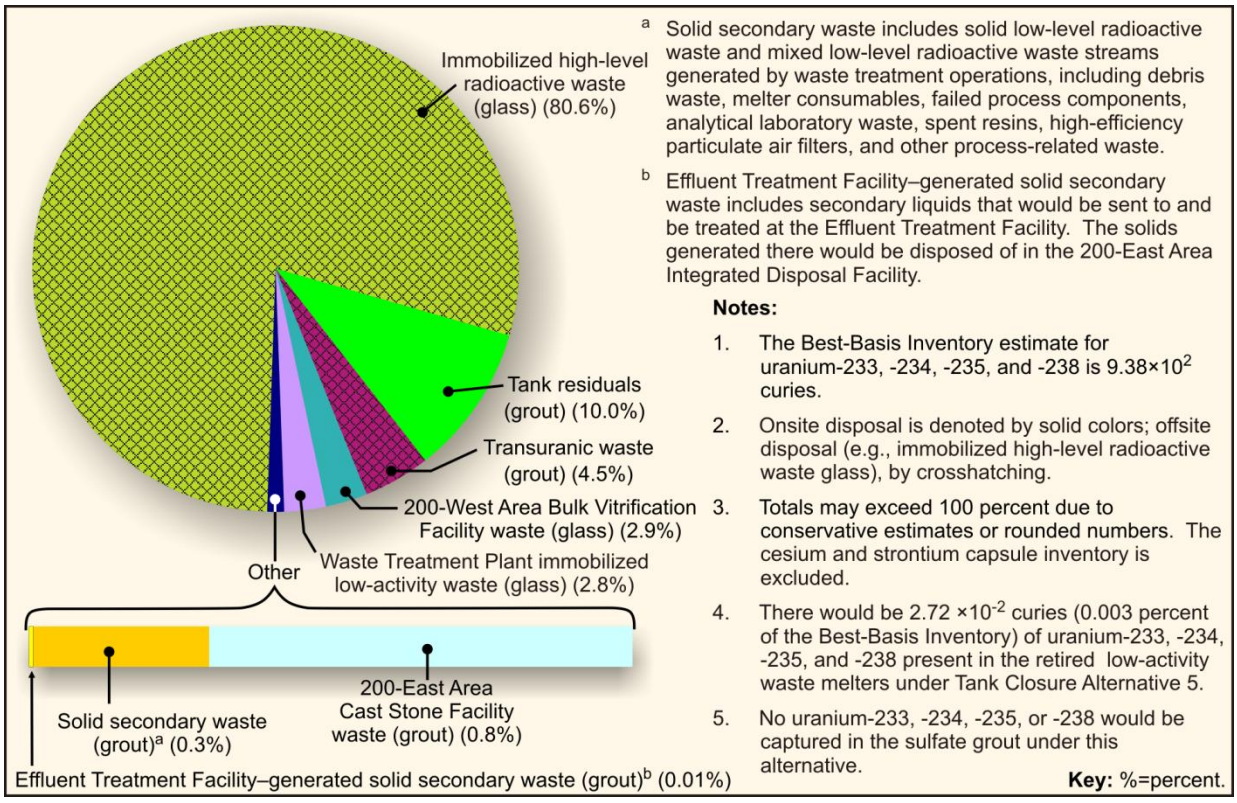


Figure D–46. Tank Closure Alternative 5 Uranium Distribution

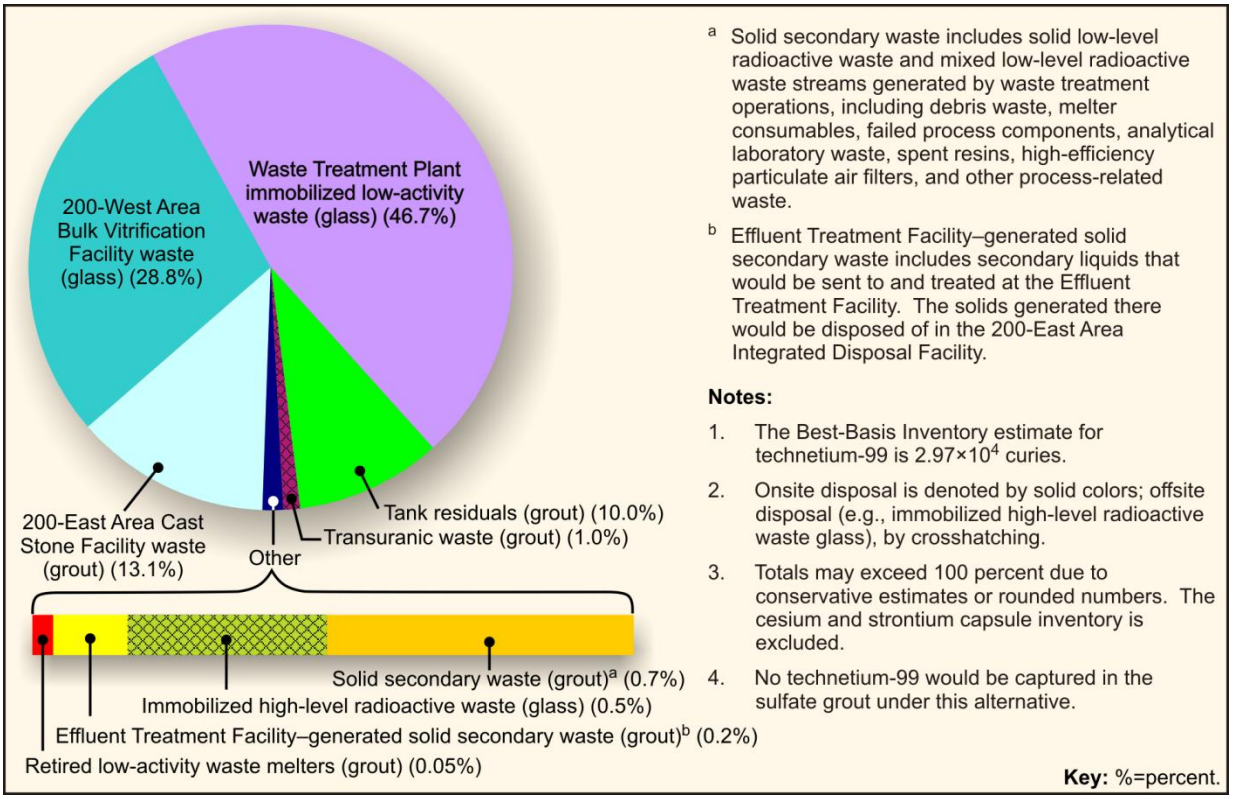


Figure D–47. Tank Closure Alternative 5 Technetium-99 Distribution

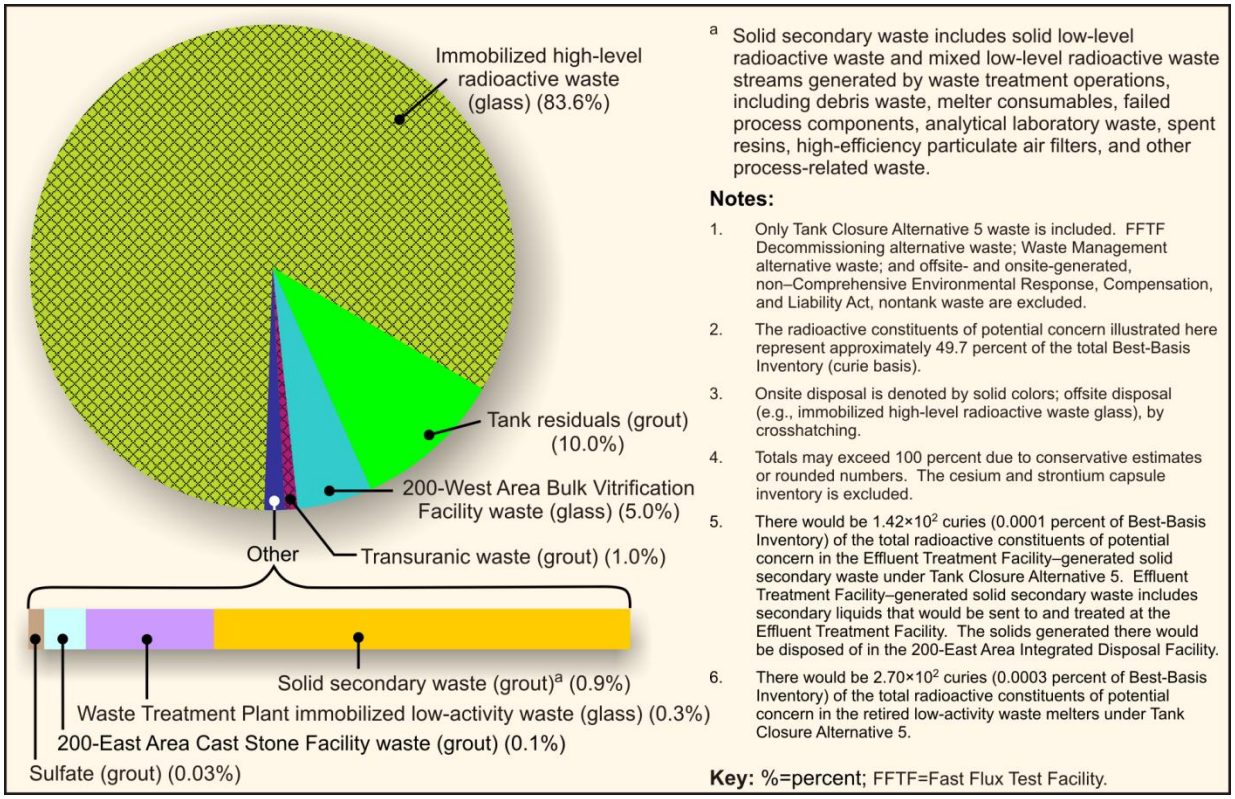
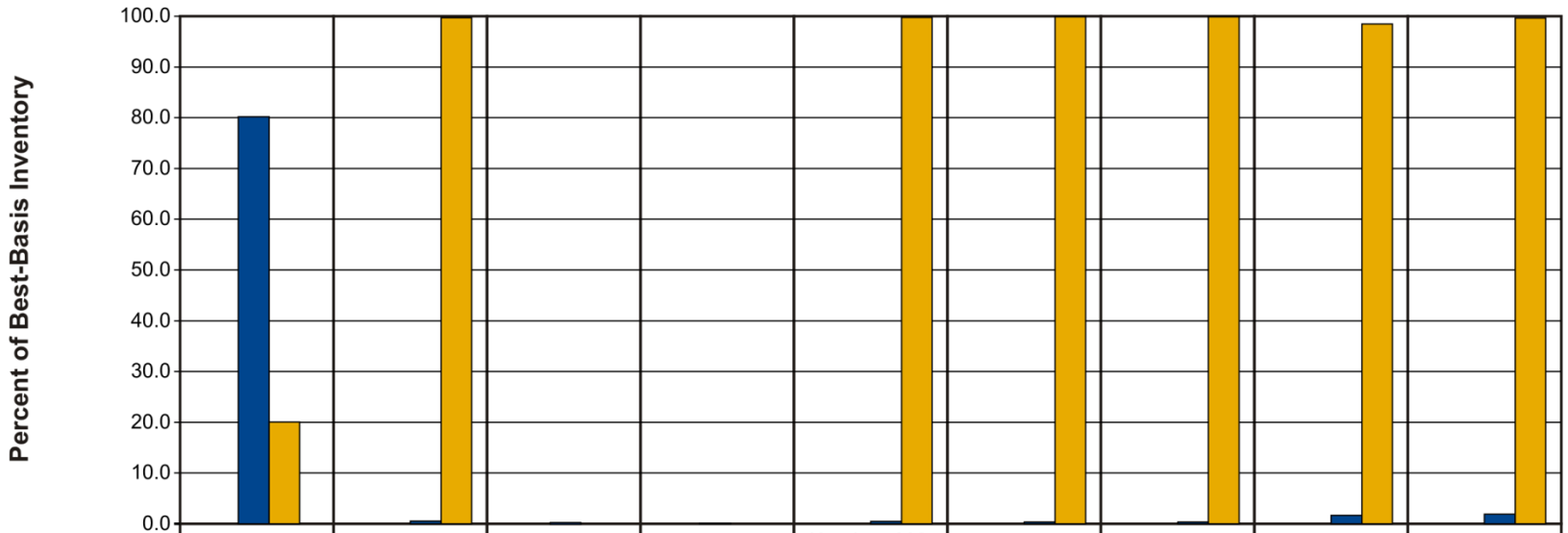


Figure D–48. Tank Closure Alternative 5 Distribution of Total Radioactive Constituents of Potential Concern



	Iodine-129	Cesium-137[a]	Carbon-14	Hydrogen-3 (Tritium)	Uranium-233, -234, -235, -238	Neptunium-237	Plutonium-239, -240	Strontium-90[a]	Technetium-99
Best-Basis Inventory (curies)	4.82×10^{1}	4.58×10^{7}	3.12×10^{3}	1.21×10^{4}	9.38×10^{2}	1.41×10^{2}	8.14×10^{4}	5.05×10^{7}	2.97×10^{4}
% disposal									
Onsite (glass)[b]	0.0	0.%	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Onsite (grout)[c]	80.6[f]	0.5	0.4	0.1	0.5	0.3	0.3	1.7	1.9
Offsite[d]	20.0	99.7	0.0	0.0	99.8	99.9	99.9	98.5	99.6
Total[e]	100.6[f]	100.2	0.4	0.1	100.3	100.2	100.2	100.1	101.5

[a] This figure excludes the inventory and secondary waste generated by the treatment of the cesium and strontium capsules.
[b] Immobilized low-activity waste glass.
[c] Tank residuals, retired low-activity waste melters, solid secondary waste, and Effluent Treatment Facility–generated solid secondary waste.
[d] Immobilized high-level radioactive waste glass.
[e] Totals may exceed 100 percent due to conservative estimates or rounded numbers. Totals may not equal the sum of the contributions due to rounding. Carbon-14 and hydrogen-3 (tritium) may not total 100 percent because portions of each would be released to the offgas streams and stack(s) or to the State-Approved Land Disposal Site.
[f] For Tank Closure Alternative 6A, Option Case, iodine-129 onsite (grout) increases to 81.1 percent and total increases to 101.2 percent due to cribs and trenches (ditches) contribution.

Note: Only Tank Closure Alternative 6A, Base Case or Option Case, waste is included. FFTF Decommissioning alternative waste; Waste Management alternative waste; offsite- and onsite-generated, non-Comprehensive Environmental Response, Compensation, and Liability Act, nontank waste; and inventories disposed of in the River Protection Project Disposal Facility are excluded. Also excluded are PPF glass and retired PPF melters.
Key: %=percent; FFTF=Fast Flux Test Facility; PPF=Preprocessing Facility.

Figure D–49. Tank Closure Alternative 6A, Base Case or Option Case, Distribution of Radioactive Constituents of Potential Concern

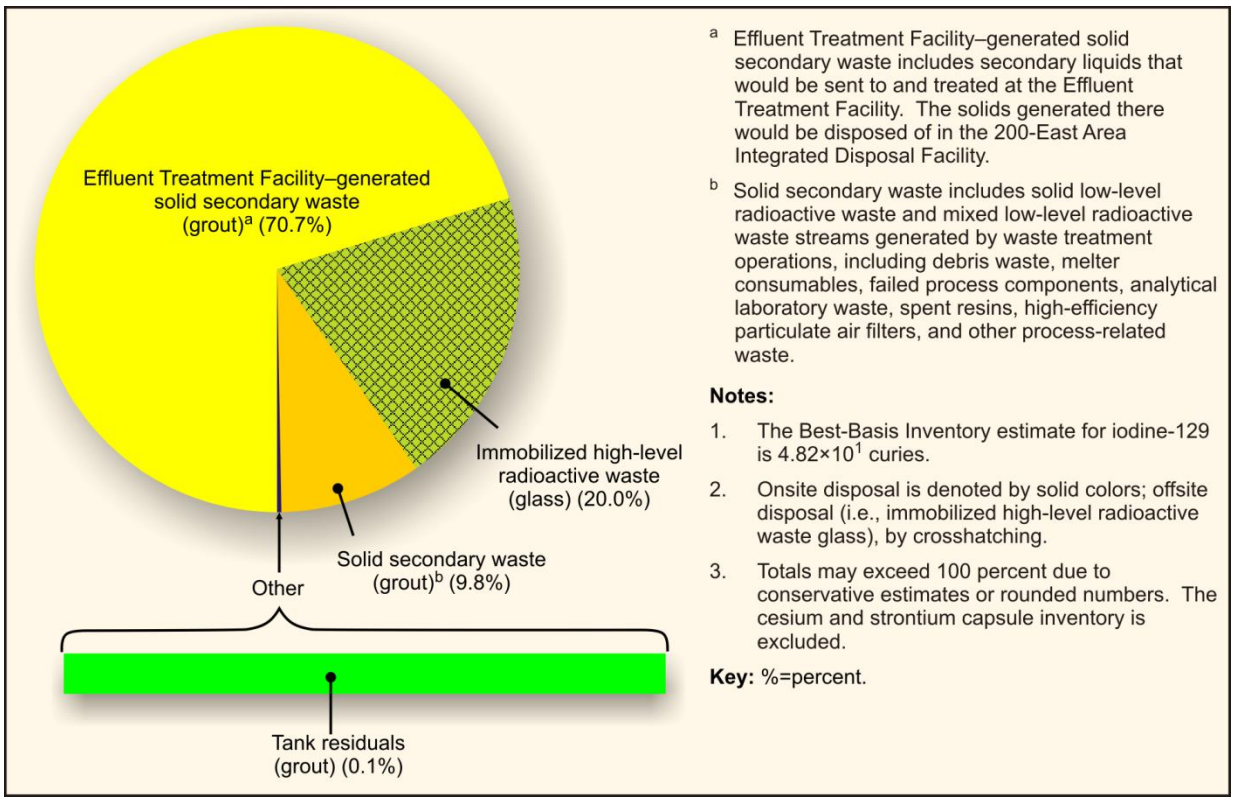


Figure D–50. Tank Closure Alternative 6A, Base Case or Option Case, Iodine-129 Distribution

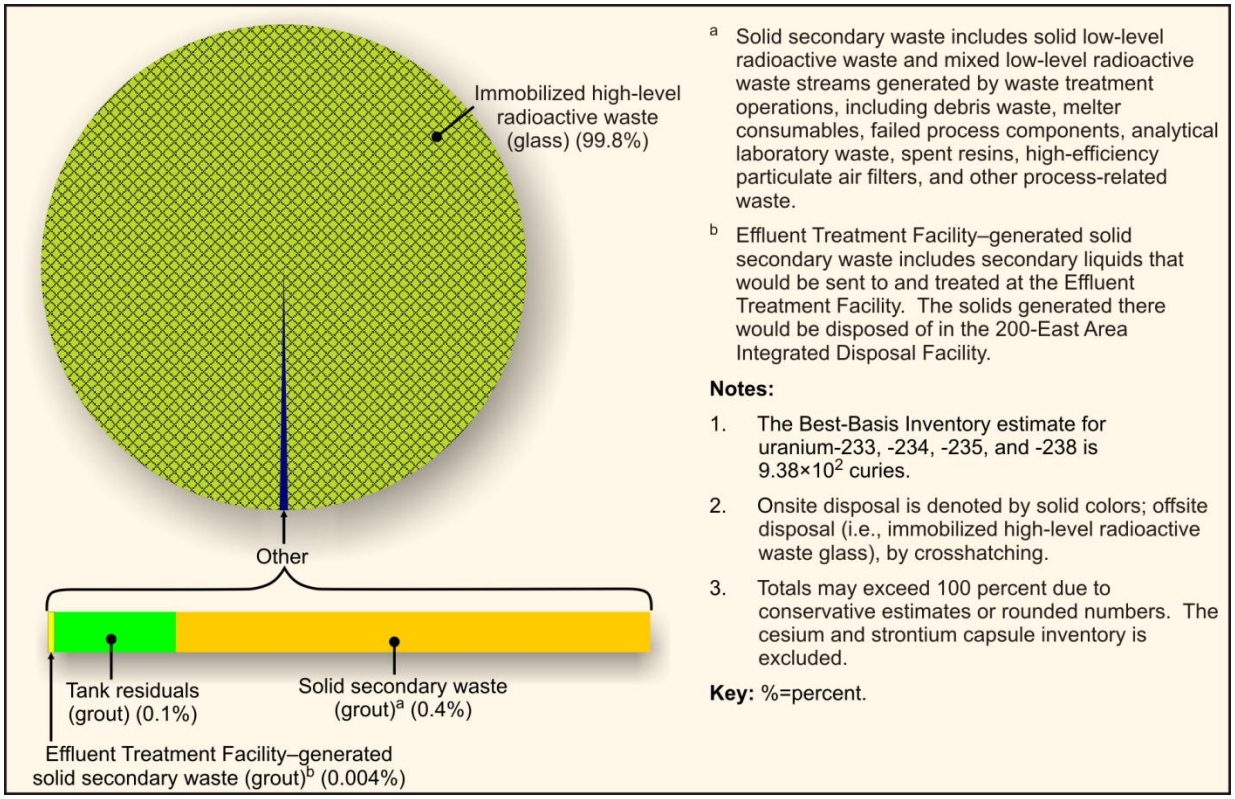


Figure D–51. Tank Closure Alternative 6A, Base Case or Option Case, Uranium Distribution

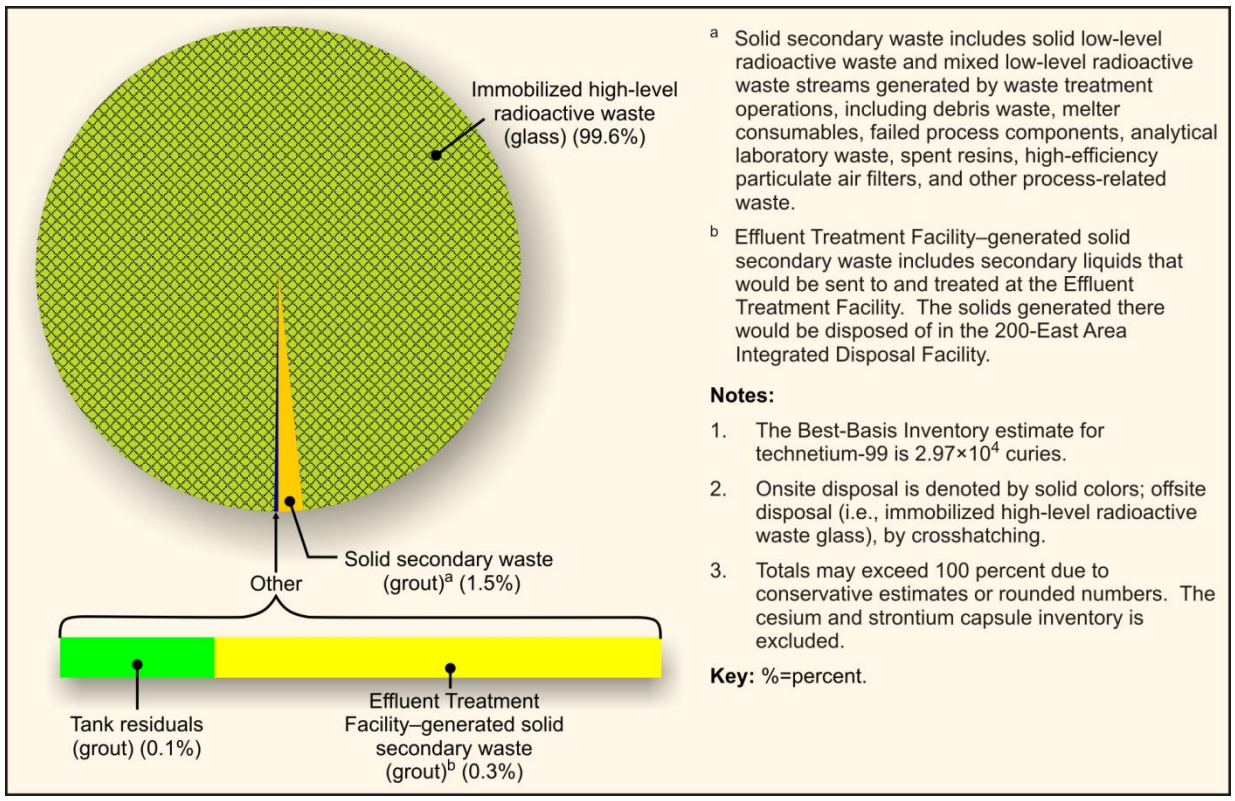


Figure D–52. Tank Closure Alternative 6A, Base Case or Option Case, Technetium-99 Distribution

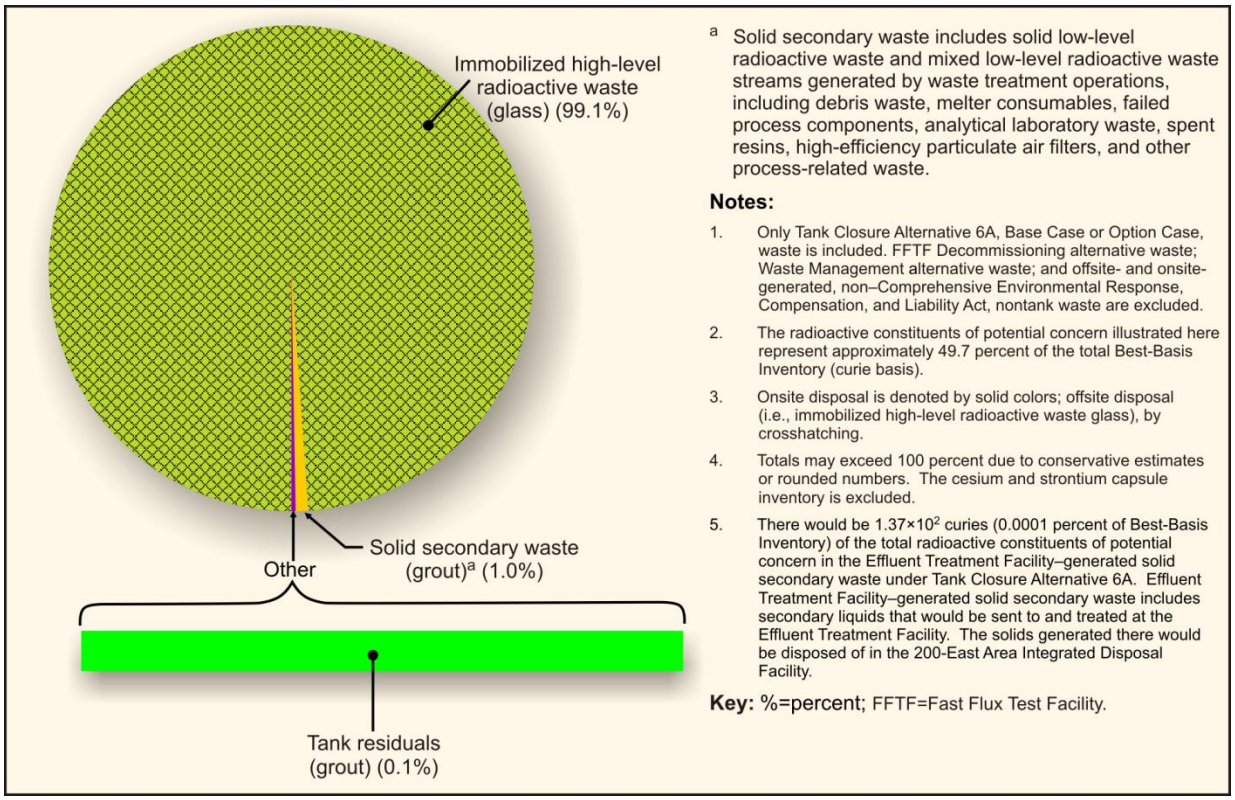
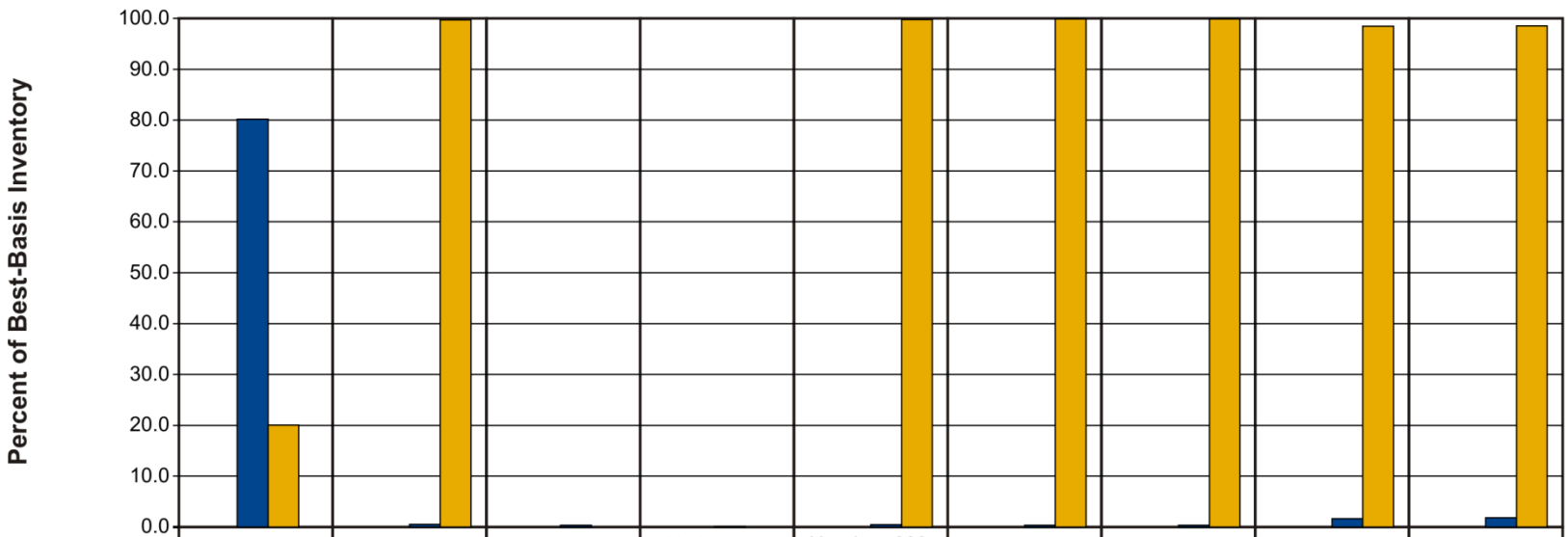


Figure D–53. Tank Closure Alternative 6A, Base Case or Option Case, Distribution of Total Radioactive Constituents of Potential Concern



	Iodine-129	Cesium-137[a]	Carbon-14	Hydrogen-3 (Tritium)	Uranium-233, -234, -235, -238	Neptunium-237	Plutonium-239, -240	Strontium-90[a]	Technetium-99
Best-Basis Inventory (curies)	4.82×10^{1}	4.58×10^{7}	3.12×10^{3}	1.21×10^{4}	9.38×10^{2}	1.41×10^{2}	8.14×10^{4}	5.05×10^{7}	2.97×10^{4}
% disposal									
Onsite (glass)[b]	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Onsite (grout)[c]	80.6[f]	0.5	0.4	0.1	0.5	0.3	0.3	1.7	1.9
Offsite[d]	20.0	99.7	0.0	0.0	99.8	99.9	99.9	98.5	98.6
Total[e]	100.6[f]	100.3	0.4	0.1	100.3	100.2	100.2	100.1	100.5

[a] This figure excludes the inventory and secondary waste generated by the treatment of the cesium and strontium capsules.
[b] Immobilized low-activity waste glass.
[c] Tank residuals, retired low-activity waste melters, solid secondary waste, and Effluent Treatment Facility–generated solid secondary waste.
[d] Immobilized high-level radioactive waste glass.
[e] Totals may exceed 100 percent due to conservative estimates or rounded numbers. Totals may not equal the sum of the contributions due to rounding. Carbon-14 and hydrogen-3 (tritium) may not total 100 percent because portions of each would be released to the offgas streams and stack(s) or to the State-Approved Land Disposal Site.
[f] For Tank Closure Alternative 6B, Option Case, iodine-129 onsite (grout) increases to 81.1 percent and total increases to 101.2 percent due to cribs and trenches (ditches) contribution.

Note: Only Tank Closure Alternative 6B, Base Case or Option Case, waste is included. FFTF Decommissioning alternative waste; Waste Management alternative waste; offsite- and onsite-generated, non-Comprehensive Environmental Response, Compensation, and Liability Act, nontank waste; and inventories disposed of in the River Protection Project Disposal Facility are excluded. Also excluded are PPF glass and retired PPF melters.
Key: %=percent; FFTF=Fast Flux Test Facility; PPF=Preprocessing Facility.

Figure D–54. Tank Closure Alternative 6B, Base Case or Option Case, Distribution of Radioactive Constituents of Potential Concern

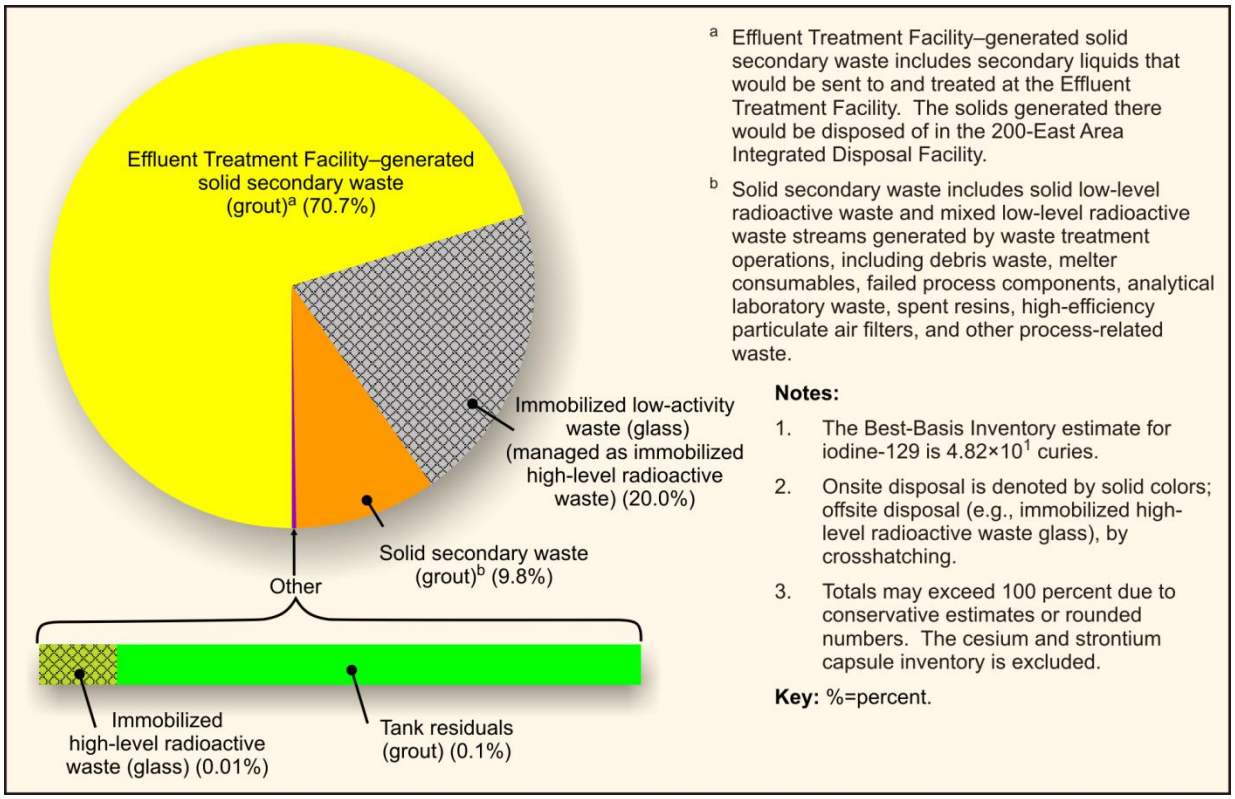


Figure D–55. Tank Closure Alternative 6B, Base Case or Option Case, Iodine-129 Distribution

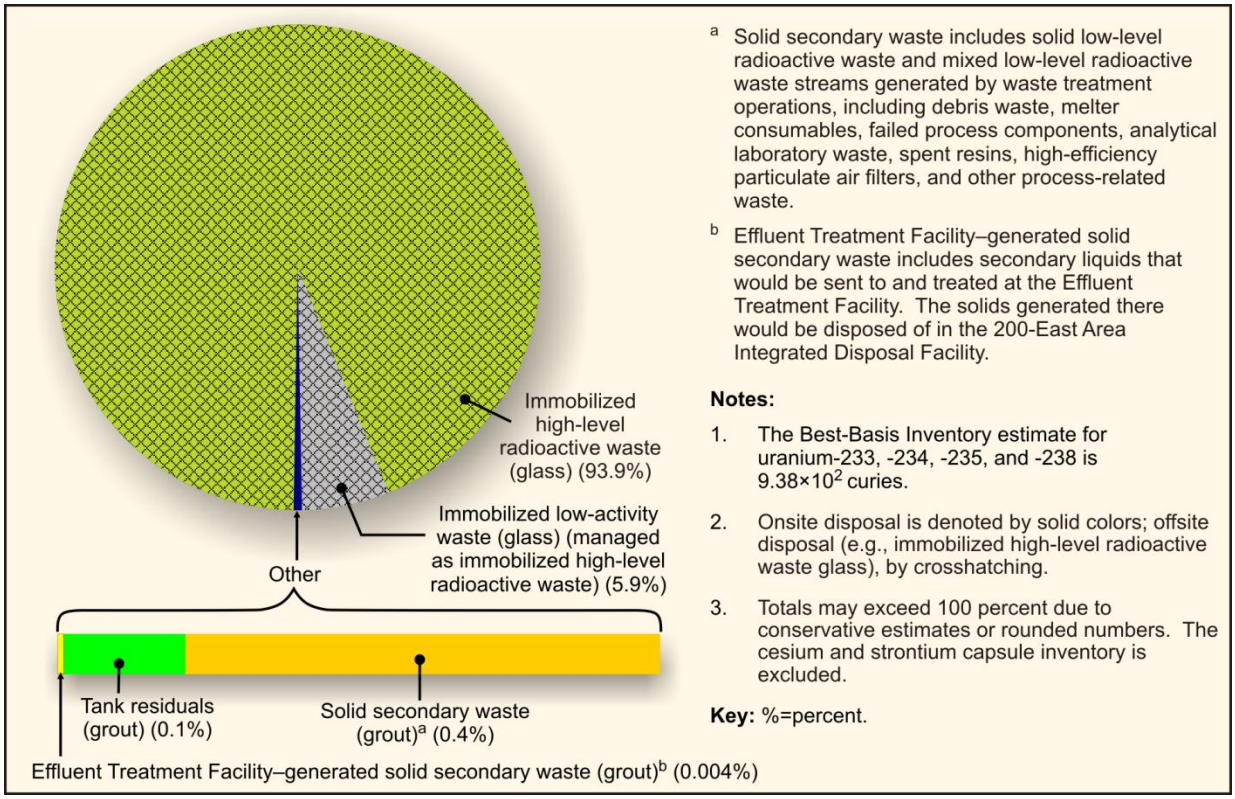


Figure D–56. Tank Closure Alternative 6B, Base Case or Option Case, Uranium Distribution

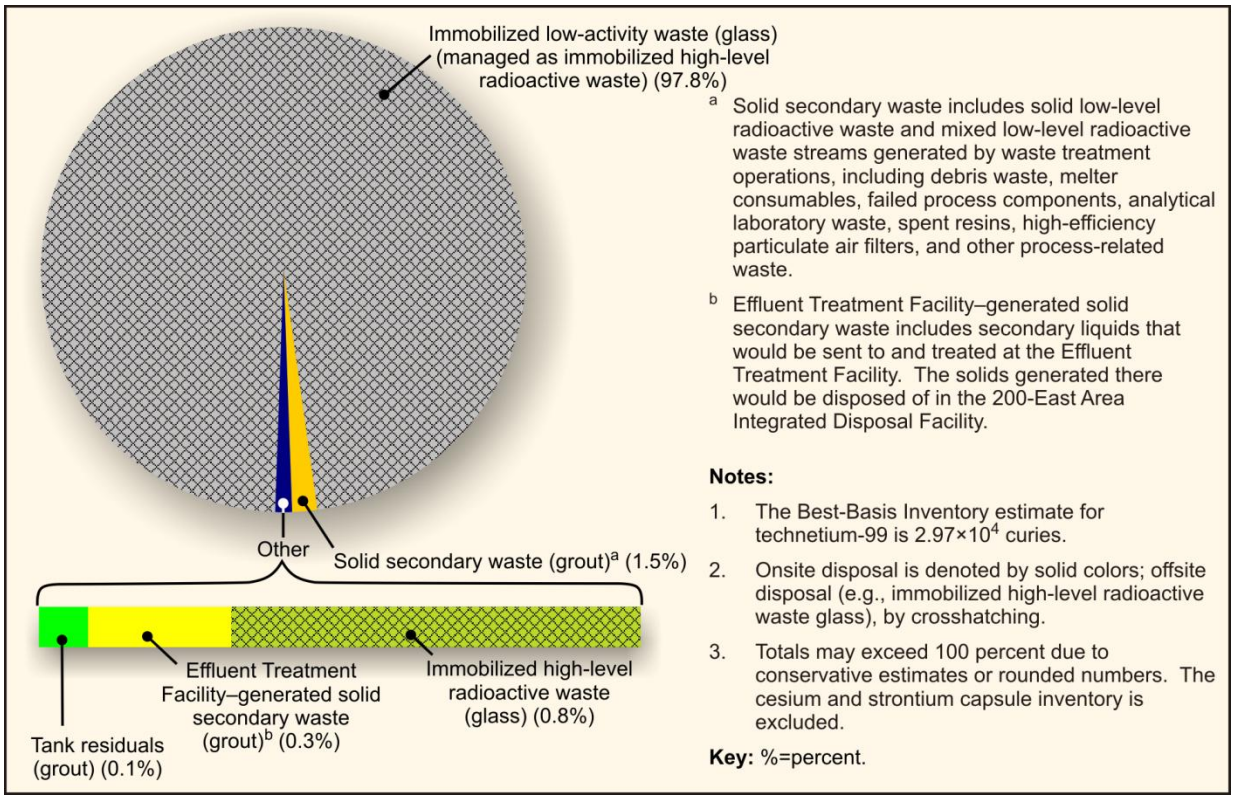


Figure D–57. Tank Closure Alternative 6B, Base Case or Option Case, Technetium-99 Distribution

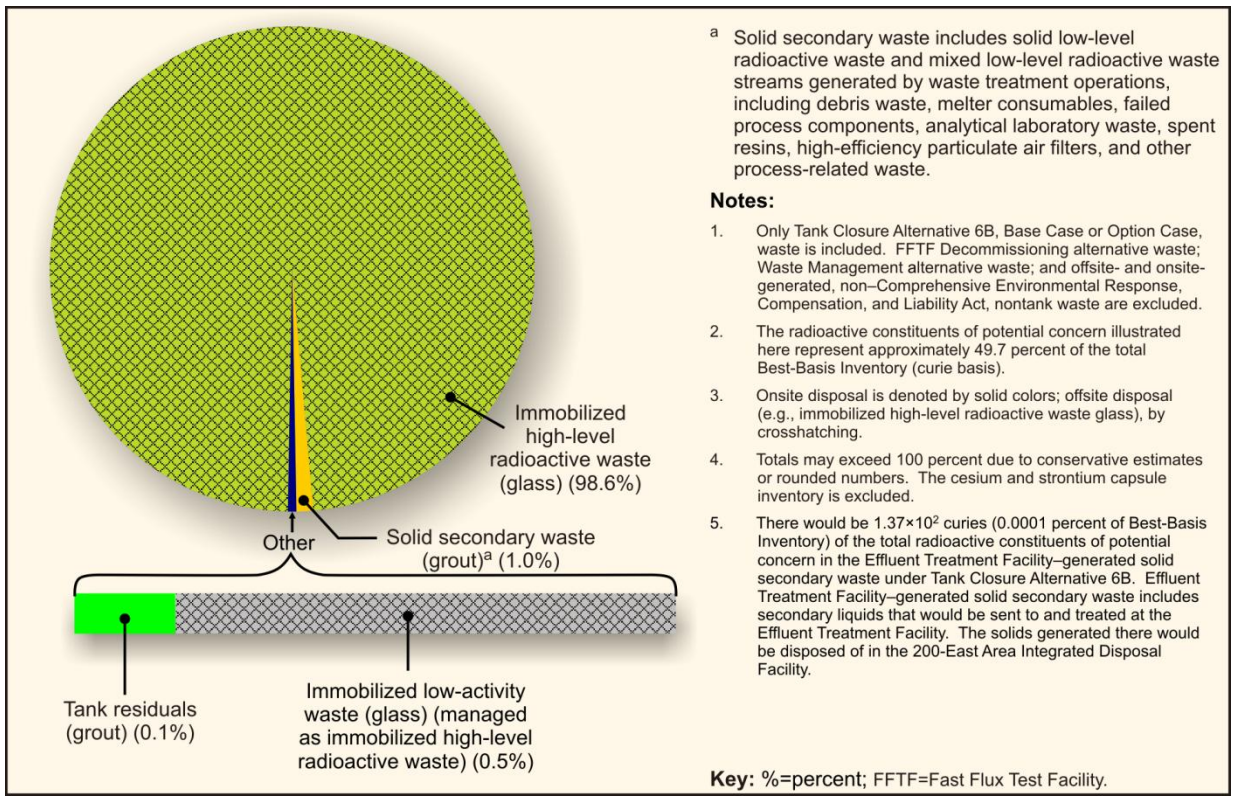
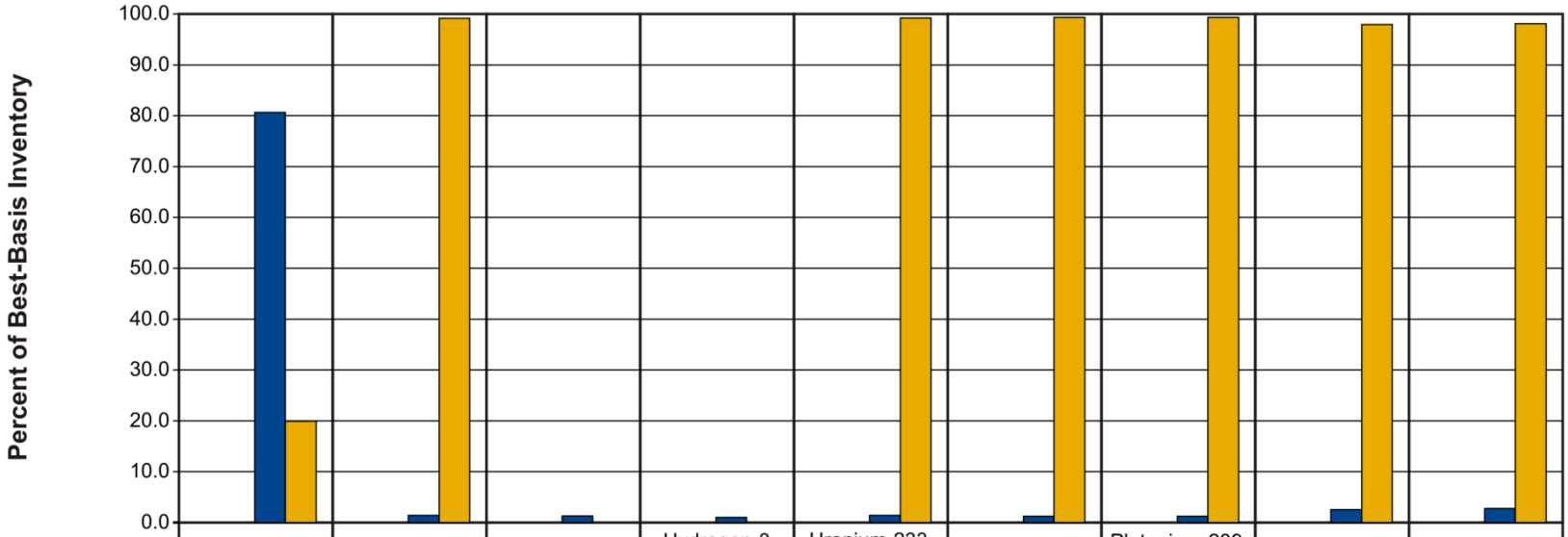


Figure D–58. Tank Closure Alternative 6B, Base Case or Option Case, Distribution of Total Radioactive Constituents of Potential Concern



	Iodine-129	Cesium-137[a]	Carbon-14	Hydrogen-3 (Tritium)	Uranium-233, -234, -235, -238	Neptunium-237	Plutonium-239, -240	Strontium-90[a]	Technetium-99
Best-Basis Inventory (curies)	4.82×10^{1}	4.58×10^{7}	3.12×10^{3}	1.21×10^{4}	9.38×10^{2}	1.41×10^{2}	8.14×10^{4}	5.05×10^{7}	2.97×10^{4}
% disposal									
Onsite (glass)[b]	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Onsite (grout)[c]	80.4	1.4	1.3	1.0	1.4	1.2	1.2	2.5	2.7
Offsite[d]	19.8	98.8	0.0	0.0	98.9	99.0	99.0	97.6	97.8
Total[e]	100.2	100.2	1.3	1.0	100.3	100.2	100.2	100.1	100.5

[a] This figure excludes the inventory and secondary waste generated by the treatment of the cesium and strontium capsules.
[b] Immobilized low-activity waste glass.
[c] Tank residuals, retired low-activity waste melters, solid secondary waste, and Effluent Treatment Facility–generated solid secondary waste.
[d] Immobilized high-level radioactive waste glass.
[e] Totals may exceed 100 percent due to conservative estimates or rounded numbers. Totals may not equal the sum of the contributions due to rounding. Carbon-14 and hydrogen-3 (tritium) may not total 100 percent because portions of each would be released to the offgas streams and stack(s) or to the State-Approved Land Disposal Site.

Note: Only Tank Closure Alternative 6C waste is included. FFTF Decommissioning alternative waste; Waste Management alternative waste; and offsite- and onsite-generated, non-Comprehensive Environmental Response, Compensation, and Liability Act, nontank waste are excluded.
Key: %=percent; FFTF=Fast Flux Test Facility.

Figure D–59. Tank Closure Alternative 6C Distribution of Radioactive Constituents of Potential Concern

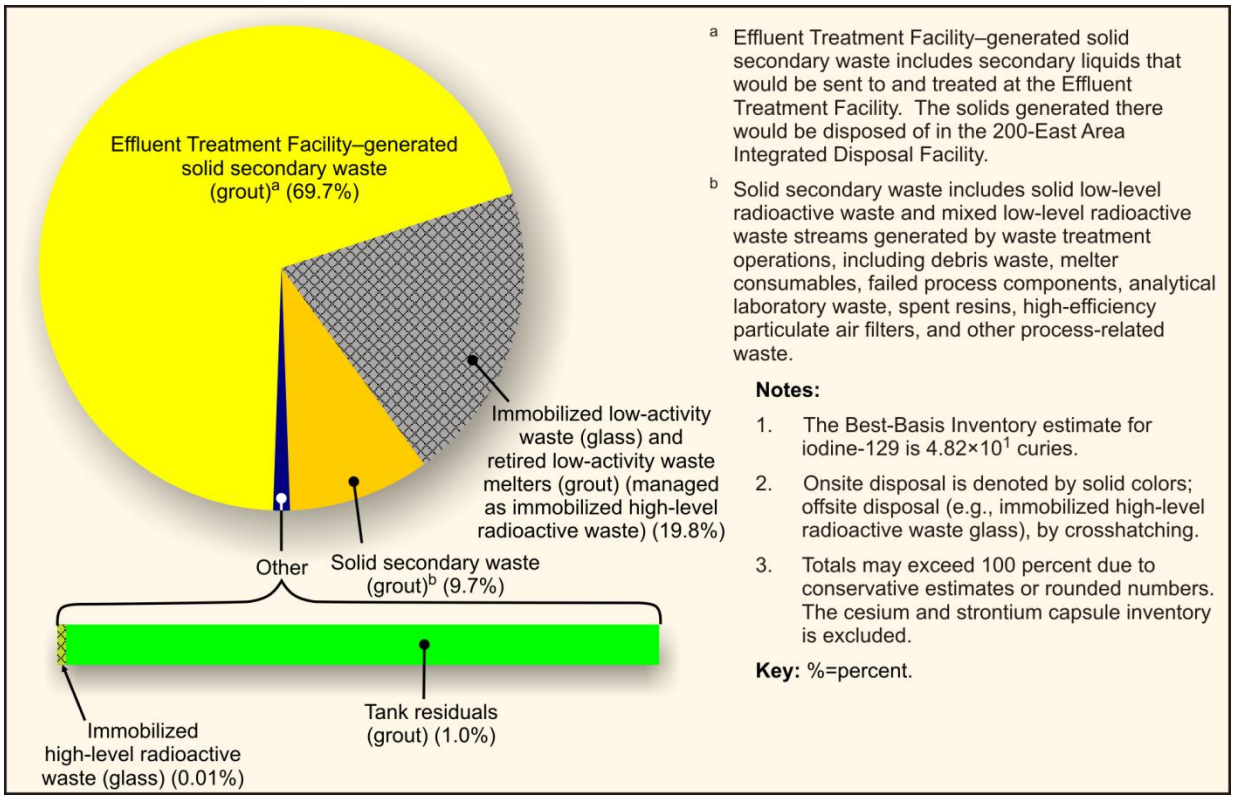


Figure D–60. Tank Closure Alternative 6C Iodine-129 Distribution

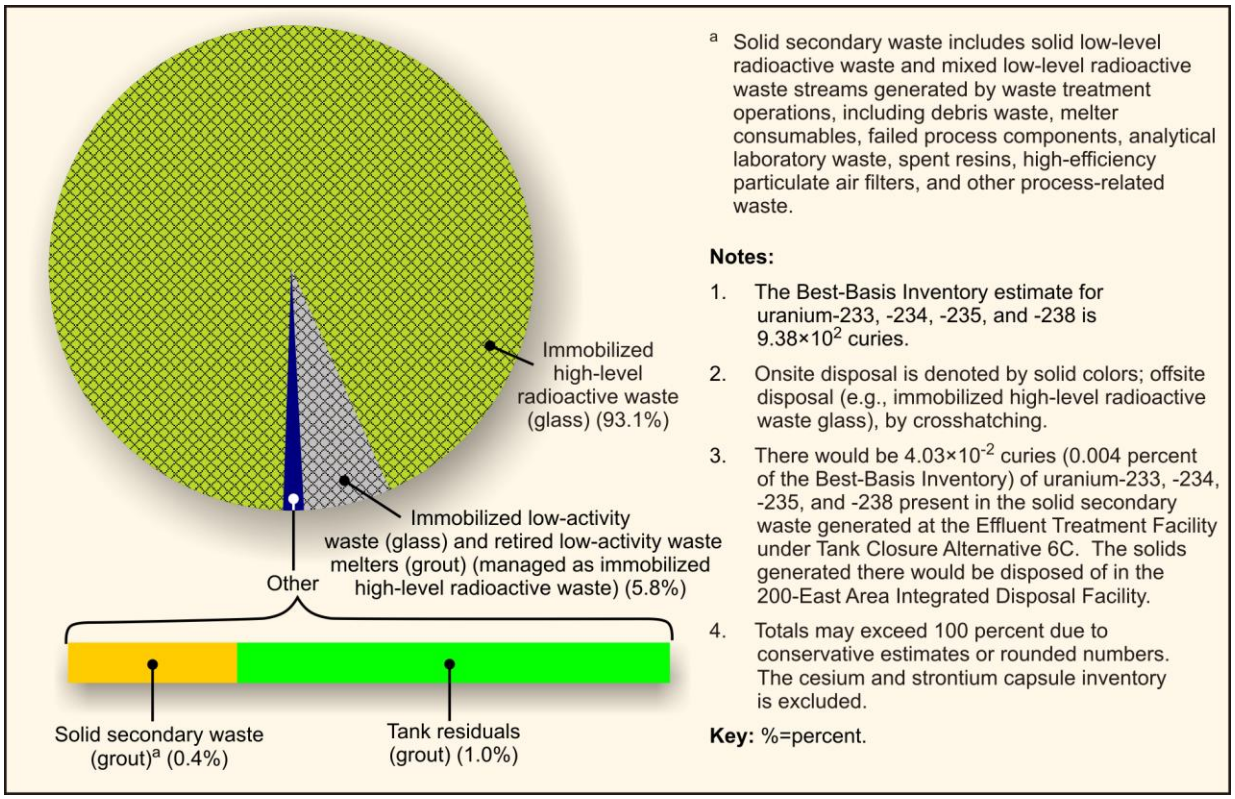


Figure D–61. Tank Closure Alternative 6C Uranium Distribution

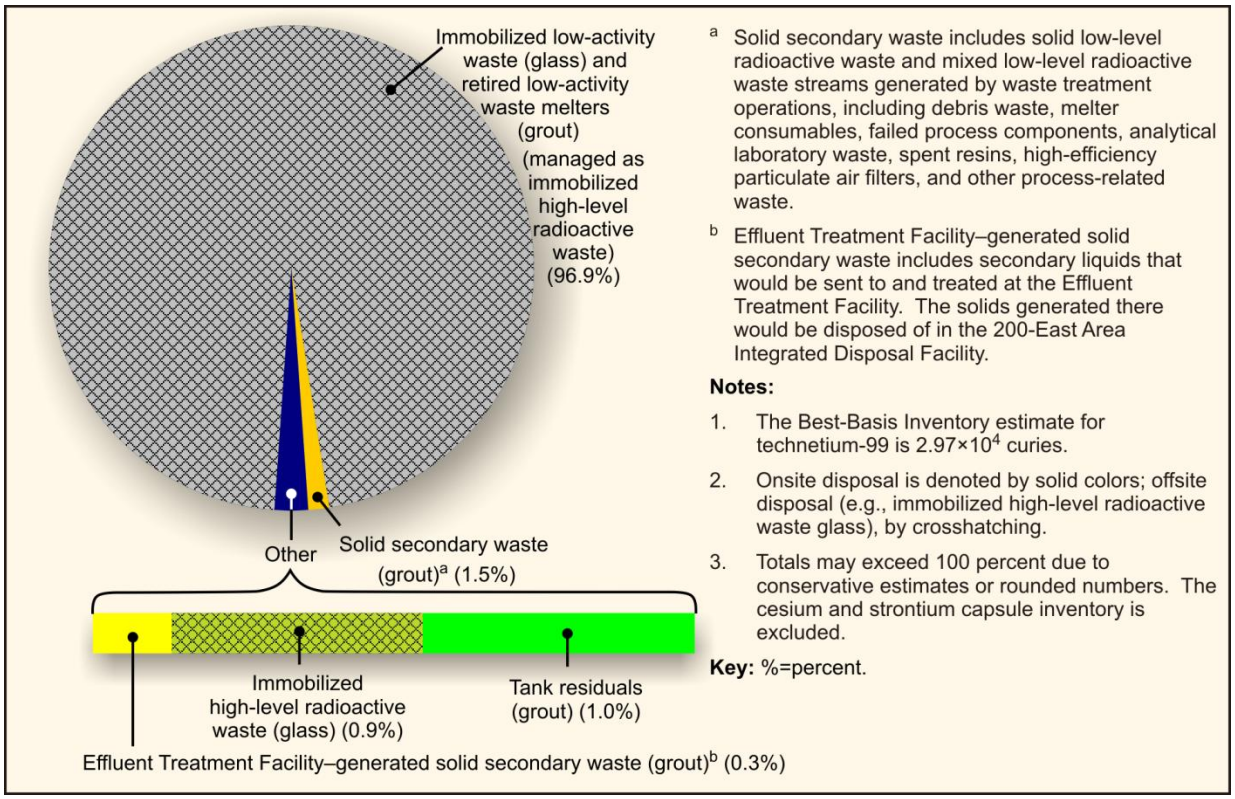


Figure D–62. Tank Closure Alternative 6C Technetium-99 Distribution

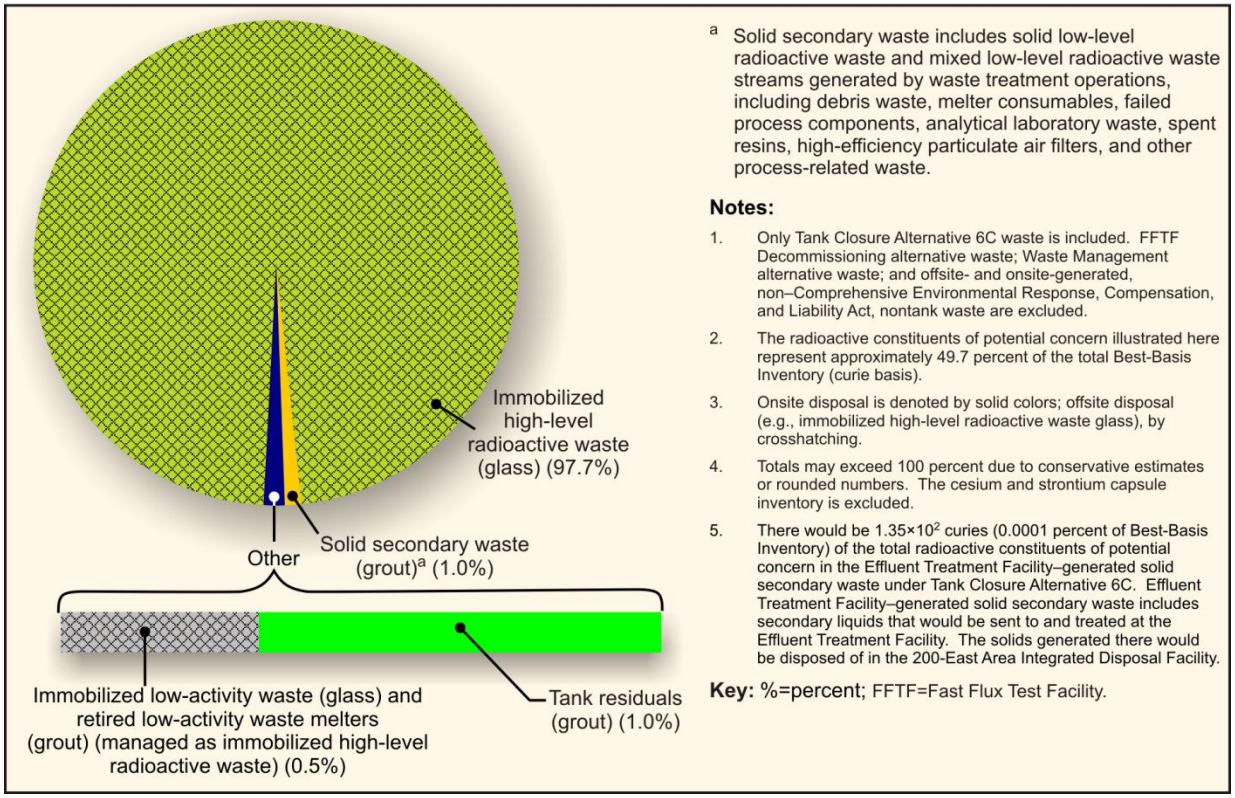


Figure D–63. Tank Closure Alternative 6C Distribution of Total Radioactive Constituents of Potential Concern

D.2 FFTF DECOMMISSIONING ALTERNATIVES

D.2.1 Radionuclide and Chemical Inventories

This section summarizes the radionuclide and chemical inventories that were analyzed for each of the three FFTF Decommissioning alternatives. Appendix E, Section E.2.3, provides a summary description of the FFTF Decommissioning alternatives analyzed in this *TC & WM EIS* and is partially reproduced in this section for the reader's convenience. The primary documentation prepared in support of the inventories presented in this section is the *FFTF Radioactive and Hazardous Materials Inventory* (CEES 2006).

The following data supported the development of the radionuclide and chemical inventories for each FFTF Decommissioning alternative.

D.2.1.1 Assumptions

Materials that were assumed to be removed during Fast Flux Test Facility (FFTF) deactivation activities include the following:

- Special nuclear materials (associated with flux monitors)
- Nuclear fuel (SNF, nonirradiated fuel)
- Ethylene glycol (approximately 355,830 liters [94,000 gallons])
- Cooling tower chemicals
- Transformer oils containing PCBs (approximately 32,180 liters [8,500 gallons])
- Freon™[1] R-12 and R-22 (approximately 13,150 kilograms [29,000 pounds])
- Sulfuric acid (approximately 5,700 liters [1,500 gallons])
- Depleted ion exchange resins (approximately 8.5 cubic meters [300 cubic feet])
- Fuel oil (approximately 374,750 liters [99,000 gallons])
- Mobiltherm™[2] oil (approximately 7,570 liters [2,000 gallons])
- Chemical inventories identified in Attachment 2 of the *Technical Information Document for the Fast Flux Test Facility Closure Project Environmental Impact Statement* (Fluor Hanford 2005a)
- Materials containing asbestos (approximately 76.5 cubic meters [100 cubic yards]) (DOE 1995, 2006a)

[1] Freon is a registered trademark of E.I. du Pont de Nemours and Company, Wilmington, Delaware.

[2] Mobiltherm is a registered trademark of Socony Mobil Oil Company, Inc., New York, New York.

D.2.1.2 Fast Flux Test Facility Inventory

The FFTF radionuclide and hazardous materials inventory is summarized in this section according to the following categories:

1. Sodium inventory
   a. Volumetric inventory of sodium
   b. Radionuclide inventory of sodium

2. Radionuclide inventory from activation
   a. Activated reactor vessel and hardware
   b. Activated concrete bioshield

3. Radionuclide inventory from contamination

4. Nonradioactive hazardous materials inventory

D.2.1.3 Fast Flux Test Facility Bulk Sodium Inventory

The FFTF sodium inventory includes (1) the sodium from the FFTF primary and secondary cooling systems, (2) the sodium in the Fuel Storage Facility and Interim Decay Storage Vessel, and (3) the sodium-potassium alloy from the secondary auxiliary cooling systems (for the primary cold trap filter and Fuel Storage Facility pool) and pressure transducers. The other Hanford bulk sodium, from the Hallam Reactor and Sodium Reactor Experiment, is described in Appendix E, Section E.2.4.1.

The total FFTF sodium inventory has been reported as approximately 984,200 liters (260,000 gallons). The volumes associated with this reported volume for the different FFTF systems are shown in Table D–73. Current estimates have reduced this sodium volume to 958,000 liters (253,000 gallons). As of June 2007, approximately 916,000 liters (242,000 gallons) of radioactively contaminated bulk sodium have been drained from the FFTF reactor vessel, three primary and three secondary heat transport system loops, the Fuel Storage Facility, and the Interim Decay Storage Vessel and associated auxiliary systems; this bulk sodium was transferred to the Sodium Storage Facility. Also, the sodium-potassium alloy, contained in pressure transducers, was removed from FFTF. Additional drainage activities that are planned would result in an estimated volume of approximately 15,140 liters (4,000 gallons) of sodium residuals in the drained systems. Appendix E, Section E.2.4.1, of this EIS contains additional descriptions of the FFTF sodium inventory (Chapin 2007).

Table D–73. Fast Flux Test Facility Systems Bulk Sodium Volumes

Fast Flux Test Facility System	Volume (liters)
Primary cooling system	530,000
Secondary cooling system	249,800
Fuel Storage Facility	117,300
Interim Decay Storage Vessel	87,100
Total[a]	**984,200**

[a] The total excludes a nominal 2,271 liters of sodium-potassium alloy that was removed from the Fast Flux Test Facility.

Note: To convert liters to gallons, multiply by 0.26417.

Source: CEES 2006.

The constituent concentrations and quantities remaining in the FFTF primary and secondary sodium loops are provided in Table D–74. At a minimum, these constituents would be present in the various components in proportion to their sodium residuals volume. Additional quantities of these constituents may be present in the components based on their function (e.g., cold traps); however, the additional quantities in the specific components are unknown.

Table D–74. Fast Flux Test Facility Sodium Contaminant Constituents

Constituent	Sodium Analysis			Constituent Inventory		
	Primary Sodium	Secondary Sodium	Units	Quantity in Sodium Residuals (15,140 liters [4,000 gallons])	Quantity in Total FFTF Sodium (984,200 liters [260,000 gallons])	Units
Silver	< 0.02	0.01	ppm by wt	2.86×10^{-4}	1.86×10^{-2}	kg
Aluminum	0.2	0.5	ppm by wt	7.17×10^{-3}	4.67×10^{-1}	kg
Boron	< 0.04	0.3	ppm by wt	4.30×10^{-3}	2.79×10^{-1}	kg
Barium	< 0.02	0.03	ppm by wt	4.30×10^{-4}	2.79×10^{-2}	kg
Bismuth	< 0.2	0.03	ppm by wt	2.86×10^{-3}	1.86×10^{-1}	kg
Calcium	0.3	0.5	ppm by wt	7.17×10^{-3}	4.67×10^{-1}	kg
Cadmium	< 0.01	< 0.1	ppm by wt	1.43×10^{-3}	9.30×10^{-2}	kg
Chlorine	–	0.5	ppm by wt	7.17×10^{-3}	4.67×10^{-1}	kg
Cobalt	< 0.02	0.4	ppm by wt	5.72×10^{-3}	3.72×10^{-1}	kg
Chromium	0.4	0.4	ppm by wt	5.72×10^{-3}	3.72×10^{-1}	kg
Cesium-137	$< 1\times10^{-10}$	–	curies per gram	1.43×10^{-3}	9.30×10^{-2}	curies
Copper	0.03	0.15	ppm by wt	2.15×10^{-3}	1.40×10^{-1}	kg
Iron	2.9	39	ppm by wt	5.58×10^{-1}	3.63×10^{1}	kg
Hydrogen-3 (tritium)	1.6×10^{-7}	–	curies per gram	2.29	1.49×10^{2}	curies
Potassium	2,312	287	ppm by wt	3.31×10^{1}	2.15×10^{3}	kg
Lithium	0.1	< 0.01	ppm by wt	1.43×10^{-3}	9.30×10^{-2}	kg
Magnesium	0.7	0.05	ppm by wt	1.00×10^{-2}	6.53×10^{-1}	kg
Manganese	0.4	0.24	ppm by wt	5.72×10^{-3}	3.72×10^{-1}	kg
Molybdenum	< 0.04	1	ppm by wt	1.43×10^{-2}	9.30×10^{-1}	kg
Sodium-22	5.2×10^{-7}	–	curies per gram	7.44	4.84×10^{2}	curies
Nickel	0.25	22	ppm by wt	3.15×10^{-1}	2.05×10^{1}	kg
Lead	0.06	0.3	ppm by wt	4.30×10^{-3}	2.79×10^{-1}	kg
Silicon	0.1	2	ppm by wt	2.86×10^{-2}	1.86	kg
Tin	5	0.02	ppm by wt	7.17×10^{-2}	4.67	kg
Strontium	< 0.01	–	ppm by wt	1.43×10^{-4}	9.30×10^{-3}	kg
Titanium	0.04	–	ppm by wt	5.72×10^{-4}	3.72×10^{-2}	kg
Total alpha	1.2×10^{-12}	–	curies per gram	1.72×10^{-5}	1.12×10^{-3}	curies
Uranium	< 2	0.001	ppm by wt	2.86×10^{-2}	1.86	kg
Vanadium	< 0.02	–	ppm by wt	2.86×10^{-4}	1.86×10^{-2}	kg

Note: To convert kilograms to pounds, multiply by 2.2046.
Key: FFTF=Fast Flux Test Facility; kg=kilograms; ppm=part(s) per million; wt=weight.
Source: CEES 2006.

Gamma energy analyses of the wastewater from cleaning sodium residuals from fuel and fuel-handling components indicated that there are five primary radionuclides present; that the beta-to-alpha ratio is greater than 700; and that cesium-137 and cobalt-60 account for greater than 70 percent of the radionuclides in the waste stream (Fluor Hanford 2005a). The five primary radionuclides in the wash wastewater and their volume percentages are as follows:

- Cesium-137: 94 to 97 percent
- Cesium-134: 2 to 3 percent
- Sodium-22: less than 1 percent
- Cobalt-60: less than 1 percent
- Manganese-54: less than 1 percent

D.2.1.4 Radionuclide Inventory from Activation

The radionuclide inventory from activation of the reactor vessel and in-vessel components and the concrete bioshield immediately surrounding the reactor vessel is provided in the following sections.

The reactor vessel and in-vessel components have a total of 900,000 curies of activation products, as shown in Table D–75. Table D–76 summarizes the data in Table D–75 and additionally reports the inventory for the Interim Examination and Maintenance (IEM) Cell items and nonfueled hardware that have become activated.

Table D–75. Activated Reactor Vessel and In-Vessel Component Inventory, Decayed to September 2003 (curies)

	C-14	Co-60	Mo-93	Nb-94	Ni-59	Ni-63	Tc-99	Total
Inner radial shield	3.09×10^{1}	1.48×10^{5}	0	7.91	1.17×10^{2}	1.13×10^{4}	0	1.59×10^{5}
Outer radial shield	1.31×10^{1}	6.49×10^{4}	0	3.78	5.45×10^{1}	5.26×10^{3}	0	7.02×10^{4}
Radial shield support	8.02×10^{-2}	3.84×10^{2}	0	1.74×10^{-2}	3.18×10^{-1}	3.12×10^{1}	0	4.16×10^{2}
Core basket	2.00×10^{-1}	8.49×10^{2}	0	3.20×10^{-2}	7.51×10^{-1}	7.48×10^{1}	0	9.25×10^{2}
Grid plate	4.67×10^{-1}	2.44×10^{3}	0	1.13×10^{-1}	1.86	1.83×10^{2}	0	2.63×10^{3}
Core support structure	8.48×10^{-2}	1.99×10^{2}	0	4.32×10^{-3}	3.00×10^{-1}	2.99×10^{1}	0	2.29×10^{2}
Reactor vessel	6.84×10^{-2}	1.66×10^{2}	0	3.91×10^{-3}	2.42×10^{-1}	2.41×10^{1}	0	1.90×10^{2}
Thermal liner	5.28×10^{-2}	1.28×10^{2}	0	2.94×10^{-3}	1.87×10^{-1}	1.85×10^{1}	0	1.47×10^{2}
Guard vessel	1.63×10^{-2}	2.88×10^{1}	0	8.01×10^{-4}	5.76×10^{-2}	5.71	0	3.46×10^{1}
Core barrel	4.31×10^{-1}	1.95×10^{3}	0	7.68×10^{-2}	1.63	1.64×10^{2}	0	2.12×10^{3}
In-vessel storage modules	9.95×10^{-2}	3.37×10^{2}	0	1.34×10^{-2}	3.45×10^{-1}	3.31×10^{1}	0	3.71×10^{2}
Baffle plate	1.41×10^{-2}	3.03×10^{1}	0	7.16×10^{-4}	5.01×10^{-2}	4.97	0	3.53×10^{1}
Instrument trees	7.28×10^{-2}	3.07×10^{2}	3.86×10^{-9}	1.11×10^{-2}	2.73×10^{-1}	2.69×10^{1}	2.02×10^{-9}	3.34×10^{2}
In-vessel handling machines	4.62×10^{-3}	7.75	6.13×10^{-9}	1.60×10^{-4}	1.63×10^{-2}	1.61	3.21×10^{-9}	9.38
Closure head assembly	1.60×10^{-5}	1.32×10^{-2}	9.58×10^{-8}	4.57×10^{-7}	1.27×10^{-4}	1.21×10^{-2}	5.66×10^{-8}	2.54×10^{-2}
Z ring	6.79×10^{-6}	1.57×10^{-2}	0	5.37×10^{-7}	2.44×10^{-5}	2.45×10^{-3}	0	1.82×10^{-2}
Boron carbide shield	3.26×10^{-8}	0	0	0	0	0	0	3.26×10^{-8}
Steel roof	2.03×10^{-3}	4.19×10^{-7}	0	4.50×10^{-9}	0	0	3.41×10^{-9}	4.27×10^{-7}

Table D–75. Activated Reactor Vessel and In-Vessel Component Inventory, Decayed to September 2003 (curies) *(continued)*

	C-14	Co-60	Mo-93	Nb-94	Ni-59	Ni-63	Tc-99	Total
Row 7 radial reflectors	2.46	1.96×10^{5}	1.06×10^{2}	1.20×10^{1}	5.77×10^{2}	7.86×10^{4}	9.63	2.75×10^{5}
Row 8 and 9 radial reflectors	2.88	2.70×10^{5}	1.17×10^{2}	1.62×10^{1}	7.96×10^{2}	1.02×10^{5}	1.31×10^{1}	3.73×10^{5}
Control and safety rods	9.40×10^{-1}	8.02×10^{3}	3.32×10^{1}	3.53	2.32×10^{1}	1.64×10^{3}	2.70	9.72×10^{3}
In-core shim assemblies	4.40×10^{-1}	3.01×10^{3}	1.83×10^{1}	1.93	1.13×10^{1}	8.10×10^{2}	1.49	3.85×10^{3}
Peripheral shim rod assemblies	8.66×10^{-3}	2.12×10^{1}	2.45×10^{-1}	2.56×10^{-2}	1.60×10^{-1}	1.10×10^{1}	1.90×10^{-2}	3.27×10^{1}
Total	**5.23×10^{1}**	**6.97×10^{5}**	**2.75×10^{2}**	**4.56×10^{1}**	**1.59×10^{3}**	**2.00×10^{5}**	**2.69×10^{1}**	**8.99×10^{5}**

Key: C=carbon; Co=cobalt; Mo=molybdenum; Nb=niobium; Ni=nickel; Tc=technetium.
Source: CEES 2006.

Table D–76. Activated Reactor Hardware, Core Components, Nonfueled Hardware, and Interim Examination and Maintenance Cell Items Inventory, Decayed to September 2003 (curies)

	C-14	Co-60	Mo-93	Nb-94	Ni-59	Ni-63	Tc-99	Total
Reactor hardware	4.56×10^{1}	2.19×10^{5}	1.06×10^{-7}	1.20×10^{1}	1.77×10^{2}	1.72×10^{4}	6.52×10^{-8}	2.37×10^{5}
Core components	6.73	4.77×10^{5}	2.75×10^{2}	3.37×10^{1}	1.41×10^{3}	1.83×10^{5}	2.69×10^{1}	6.62×10^{5}
Nonfueled hardware	4.09×10^{-2}	2.90×10^{3}	1.67	2.05×10^{-1}	6.93	1.11×10^{3}	1.63×10^{-1}	4.02×10^{3}
IEM Cell items	4.01×10^{-2}	2.84×10^{3}	1.63	2.10×10^{-1}	6.79	1.08×10^{3}	1.60×10^{-1}	3.93×10^{3}
Total	**5.24×10^{1}**	**7.02×10^{5}**	**2.78×10^{2}**	**4.61×10^{1}**	**1.60×10^{3}**	**2.02×10^{5}**	**2.72×10^{1}**	**9.07×10^{5}**

Key: C=carbon; Co=cobalt; IEM=Interim Examination and Maintenance; Mo=molybdenum; Nb=niobium; Ni=nickel; Tc=technetium.
Source: CEES 2006.

The FFTF reactor operated from April 1982 to March 1992 at a time-averaged power level of 206 megawatts. The bioshield surrounding the FFTF reactor vessel is constructed of magnetite concrete with carbon steel rebar and liner. The calculated radionuclide activation products in the bioshield are presented in Table 4.16 of *Activation of the FFTF Biological Shield Wall* (Kidd 2005), which shows them decayed for 13.5 years (September 2006 values) (CEES 2006). These data are reproduced in Table D–77.

Table D–77. Activation Inventory of Fast Flux Test Facility Bioshield, Decayed to September 2006 (curies)

	Liner	Rebar	Concrete	Total
Hydrogen-3 (tritium)	2.28×10^{-8}	2.34×10^{-8}	1.73×10^{-5}	1.73×10^{-5}
Argon-39	–	–	1.58×10^{-5}	1.58×10^{-5}
Argon-42	–	–	1.67×10^{-9}	1.67×10^{-9}
Beryllium-10	9.24×10^{-12}	2.81×10^{-11}	–	3.73×10^{-11}
Carbon-14	4.36×10^{-8}	1.81×10^{-7}	7.65×10^{-4}	7.65×10^{-4}
Calcium-41	–	–	1.54×10^{-2}	1.54×10^{-2}
Calcium-48	–	–	4.32×10^{-27}	4.32×10^{-27}
Cobalt-60	2.15×10^{-1}	3.07×10^{-1}	4.66×10^{-4}	5.22×10^{-1}
Cobalt-60m	–	3.50×10^{-16}	1.89×10^{-13}	1.90×10^{-13}
Chromium-50	1.81×10^{-25}	1.68×10^{-25}	5.06×10^{-25}	8.55×10^{-25}
Iron-55	1.99	3.57	1.19×10^{1}	1.74×10^{1}
Iron-60	–	3.50×10^{-16}	1.89×10^{-13}	1.90×10^{-13}

Table D–77. Activation Inventory of Fast Flux Test Facility Bioshield, Decayed to September 2006 (curies) *(continued)*

	Liner	Rebar	Concrete	Total
Potassium-40	–	–	1.24×10^{-8}	1.24×10^{-8}
Potassium-42	–	–	1.67×10^{-9}	1.67×10^{-9}
Manganese-53	2.24×10^{-10}	1.99×10^{-10}	6.13×10^{-10}	1.04×10^{-9}
Molybdenum-100	–	8.16×10^{-29}	–	8.16×10^{-29}
Molybdenum-93	–	1.85×10^{-5}	–	1.85×10^{-5}
Niobium-91	–	9.92×10^{-10}	–	9.92×10^{-10}
Niobium-92	–	3.92×10^{-13}	–	3.92×10^{-13}
Niobium-93m	–	1.01×10^{-5}	–	1.01×10^{-5}
Niobium-94	–	1.34×10^{-11}	–	1.34×10^{-11}
Nickel-59	–	3.94×10^{-4}	2.47×10^{-1}	2.47×10^{-1}
Nickel-63	–	4.25×10^{-2}	2.67×10^{1}	2.68×10^{1}
Phosphorus-32	2.36×10^{-11}	5.71×10^{-11}	–	8.07×10^{-11}
Scandium-48	–	–	6.91×10^{-28}	6.91×10^{-28}
Silicon-32	2.36×10^{-11}	5.71×10^{-11}	–	8.07×10^{-11}
Technetium-99	–	4.52×10^{-6}	–	4.52×10^{-6}
Vanadium-50	–	3.00×10^{-21}	1.76×10^{-18}	1.76×10^{-18}
Zinc-70	–	–	2.49×10^{-22}	2.49×10^{-22}
Zirconium-93	–	2.33×10^{-12}	–	2.33×10^{-12}
Zirconium-96	–	5.02×10^{-31}	–	5.02×10^{-31}
Total	**2.21**	**3.92**	**3.89×10^{1}**	**4.50×10^{1}**

Source: CEES 2006.

D.2.1.5 Radionuclide Inventory from Contamination

Contamination within FFTF is primarily confined to the reactor containment vessel, internal surfaces of system components that handled primary sodium and radioactive argon, cells within the Reactor Containment Building (RCB), decontamination areas, liquid radioactive waste holding and exporting systems, sodium removal and sampling systems, fuel handling systems, IEM Cell, and Contaminated Equipment Repair Shop. The contaminated areas within the FFTF facilities are listed in Table D–78.

A hot spot of 150 roentgens per hour on contact was identified in the piping downstream of the 5-standard-cubic-foot-per-minute vapor trap (York 2005). This radiation level correlates with an estimated source of 3.5 curies of cesium-137.

The *Technical Information Document for the Fast Flux Test Facility Closure Project Environmental Impact Statement* (Fluor Hanford 2005a) identifies the IEM Cell as the cell with the greatest amount of contamination. The FFTF Decommissioning alternatives scaled data sets (SAIC 2010b) estimate that contamination within the IEM Cell equates to 9.95×10^{-4} curies of cesium-137, decayed to 2005. This indicates that the inventory due to contamination makes up a very small fraction of the inventory associated with activated structures and components.

Table D–78. Contaminated Areas Within the Fast Flux Test Facility

Building	Cell Number	Description	Average Contamination Level (dpm/100 cm^2)
Reactor Containment Building	524	Heat compartment	No data[a]
	528	Fuel transfer port adapter storage	0
	544	CLEM grapple change box pit	No data[a]
	548	IEM Cell	5.16×10^4 (1998)
	549	Radioactive argon gas pipeline	0
	567	Electromagnetic pump cell	No data[a]
	FTP 1	–	8.72×10^4 (2002)
	FTP 2	–	3.75×10^4 (1997)
	FTP 3	–	7.00×10^3 (1997)
Heat Transport System Service Building South	490	Sodium sampling cell	No data[a]
Reactor Service Building	201	Sodium Removal System	No data[a]
	205	Sodium Removal System	No data[a]
Maintenance and Storage Facility	–	Decontamination I	No data[a]
	–	Decontamination II	No data[a]
	–	Contaminated Equipment Repair Shop	No data[a]
	17	Radioactive Liquid Waste Tank Area	No data[a]

[a] These areas are identified as contaminated or potentially contaminated, but no survey data or contamination estimates are available.

Key: CLEM=Closed-Loop Ex-Vessel Machine; dpm/100 cm^2=disintegrations per minute per 100 square centimeters; FTP=fuel transfer port; IEM=Interim Examination and Maintenance.

Source: CEES 2006.

D.2.1.6 Hazardous Materials Inventory

The following materials are either planned for removal or have been removed from FFTF during the deactivation activities: ethylene glycol, Mobiltherm™ oil, transformer oils containing PCBs, cooling tower chemicals, sulfuric acid, Freon™ R-12 and R-22, depleted ion exchange resins, fuel oil, and asbestos-containing materials. The balance of the chemical inventory is identified in Attachment 2 of the *Technical Information Document for the Fast Flux Test Facility Closure Project Environmental Impact Statement* (Fluor Hanford 2005a).

The remaining hazardous materials include approximately 47,900 kilograms (105,600 pounds) of lead and 37,694 kilograms (83,100 pounds) of depleted uranium. The lead would be removed to the extent practicable during FFTF deactivation activities (DOE 2006a). The depleted uranium would remain in the facility under FFTF Decommissioning Alternatives 1 and 2 and would be removed under FFTF Decommissioning Alternative 3.

D.2.2 FFTF Decommissioning Alternative 1: No Action

Council on Environmental Quality regulations require that National Environmental Policy Act analyses include a No Action Alternative. Under this alternative, deactivation of the FFTF complex and support buildings would be completed, as specified by previous FFTF National Environmental Policy Act decisions (*Environmental Assessment, Sodium Residuals Reaction/Removal and Other Deactivation Work Activities, Fast Flux Test Facility (FFTF) Project, Hanford Site, Richland, Washington* [DOE 2006a]), and maintained in a long-term surveillance and maintenance (S&M) condition for the foreseeable future. The facility would be monitored and periodic S&M would be performed to ensure that the environmental and safety issues are minimized and addressed.

D.2.2.1 Facility Disposition

The FFTF RCB, along with the rest of the buildings within the 400 Area Property Protected Area (PPA), would be maintained in a long-term S&M condition after completion of all deactivation activities. The buildings would be left standing with a maintained exterior that would be capable of protecting them from the elements. They would be unoccupied, with essential safety-related systems left operational. Such systems could include, but would not be limited to, fire protection, emergency lighting, ventilation, air monitoring, and inert gas systems used to isolate piping and equipment containing sodium residuals. Other radioactive or chemical waste and materials would be removed during deactivation.

D.2.2.2 Process Components

The reactor vessel, piping systems, and tanks (contained above and below grade within the RCB and immediately adjacent buildings) would be left in place under an inert gas blanket. Deactivation activities would be complete, including draining of the bulk sodium and removal of SNF, lead shielding, remote-handled special components, small-bore piping, valves, and other components. Some systems would be deactivated and de-energized and isolated (e.g., those not associated with maintaining safety-related functions) per the deactivation plans.

D.2.2.3 Sodium Residuals

Sodium residuals in the RCB vessels and cooling systems' piping would be left in place untreated, but under an inert gas blanket. During deactivation activities, the FFTF bulk sodium would be drained from the reactor systems and stored as a solid in tanks in the Sodium Storage Facility within the 400 Area. The small amount of sodium-potassium alloy would be blended with the content of the bulk sodium storage containers. The Hallam Reactor and Sodium Reactor Experiment sodium would remain in its current storage location (Hanford 200-West Area).

D.2.2.4 Demolition and Other Waste

There would be no demolition under the No Action Alternative; therefore, no demolition waste would be generated. Solid and liquid radioactive and/or hazardous waste generated during deactivation would be managed and disposed of on site. Activities associated with the No Action Alternative would not generate substantial additional quantities of solid waste for disposal. The small amounts of radioactive solid waste generated during S&M activities would be disposed of on site in disposal facilities approved for Hanford's operational waste at Low-Level Radioactive Waste Burial Ground (LLBG) 218-W-5, trenches 31 and 34. Other regulated waste, such as PCBs, asbestos, and hazardous waste, would be handled in a similar manner under all of the alternatives. The volume of this waste is expected to be small, and it would be disposed of in accordance with existing *Hanford Site Solid Waste Acceptance Criteria* (Fluor Hanford 2005b) or offsite treatment contracts.

D.2.2.5 End State

The facilities and infrastructure within the 400 Area PPA, including the RCB, would be maintained in a 100-year administrative control condition with appropriate monitoring and controls (to ensure that environmental or safety concerns are minimized) (SAIC 2010b).

Matching the list of radionuclides and chemicals identified in the above tables with the COPCs identified in Appendix D, Section D.1.1, resulted in a report of the following radionuclides (in curies): cesium-137, carbon-14, tritium, and technetium-99, as well as the following chemicals (in kilograms): chromium, lead, and uranium. Table D–79 summarizes each of these radioactive and chemical COPCs under FFTF Decommissioning Alternative 1.

Table D–79. FFTF Decommissioning Alternative 1 Radioactive and Chemical Constituents of Potential Concern Balance

	Cesium-137	Carbon-14	Hydrogen-3 (Tritium)	Technetium-99	Chromium	Lead	Total Uranium
	Curies				Kilograms		
Inventory Remaining at the FFTF Site							
Sodium residuals[a]	1.43×10^{-3}	0	2.29	0	5.72×10^{-3}	4.30×10^{-3}	2.86×10^{-2}
Hardware[b]	0	5.24×10^{1}	0	2.72×10^{1}	0	0	3.77×10^{4}
Bioshield	0	7.65×10^{-4}	1.73×10^{-5}	4.52×10^{-6}	0	0	0
Total Remaining Inventory	**1.43×10^{-3}**	**5.24×10^{1}**	**2.29**	**2.72×10^{1}**	**5.72×10^{-3}**	**4.30×10^{-3}**	**3.77×10^{4}**
Inventory Disposed of in LLBG 218-W-5, Mixed Waste Trenches 31 and 34							
Secondary waste[c]	1.43×10^{-3}	5.31×10^{-5}	1.88×10^{-6}	1.19×10^{-3}	1.42×10^{-4}	1.07×10^{-4}	2.14×10^{-2}

[a] The inventory for the approximately 15,142 liters (4,000 gallons) of sodium residuals includes FFTF components, e.g., the reactor and miscellaneous traps.

[b] Hardware includes activated reactor hardware, the depleted uranium shield, core components, nonfueled hardware, and Interim Examination and Maintenance Cell items.

[c] Secondary-waste inventories were estimated from 2006 *Solid Waste Integrated Forecast Technical (SWIFT) Report, FY2006–FY2035* database information (Barcot 2005). For analysis purposes, it was conservatively assumed that 100 percent of the cesium-137 inventory would be captured in the secondary waste.

Note: To convert kilograms to pounds, multiply by 2.2046.

Key: FFTF=Fast Flux Test Facility; LLBG=low-level radioactive waste burial ground.

Source: SAIC 2011.

D.2.3 FFTF Decommissioning Alternative 2: Entombment

Under this alternative, the portions of the FFTF RCB (and structures within) that are above grade level (i.e., 168 meters [550 feet] above mean sea level) would be decontaminated as necessary, dismantled, and removed. The RCB structures below grade level, as well as the FFTF reactor vessel and radioactive and contaminated equipment, piping, and other materials and components that have become radioactive or otherwise contaminated, would remain in place. Sodium residuals would be removed from the RCB and treated either in existing 400 Area facilities or in place. In addition, the below-grade RCB structures would be filled with grout or other suitable fill material to immobilize remaining hazardous chemicals and radioactive materials to the maximum extent practicable and to prevent subsidence. The RCB fill material may include other demolition debris containing hazardous or radioactive materials, as allowed by regulations. An engineered, modified Resource Conservation and Recovery Act (RCRA)

Subtitle C barrier that is compliant with regulations would be constructed over the filled area. The entombed area would include the barrier together with the lower RCB and adjacent structures and immobilized internal structures.

The FFTF support buildings would be decontaminated as necessary and demolished. The area previously occupied by the facilities would be backfilled with soil to eliminate void spaces, compacted such that natural settling would not result in depressions (to avoid potential ponding of water), recontoured, and revegetated. An appropriate monitoring program for the PPA would also be established. The following sections provide additional descriptions of the activities that would be conducted under FFTF Decommissioning Alternative 2.

D.2.3.1 Facility Disposition

Appendix E, Table E–14, summarizes the proposed decommissioning activities for each building under both FFTF Decommissioning Alternative 2: Entombment and FFTF Decommissioning Alternative 3: Removal. Under the Entombment Alternative, all above-grade structures that are part of the main RCB and the two immediately adjacent support facilities (Buildings 491E and 491W) would be dismantled, and the demolition waste would be disposed of in an IDF or consolidated in the below-grade spaces. Below-grade structures would be filled with demolition waste, as practicable, and stabilized with suitable fill material (e.g., grout) to immobilize hazardous chemical and radioactive materials and prevent subsidence in the future.

All other ancillary buildings, including their internal equipment and components, would be demolished, as noted in Appendix E, Table E–14, and the contaminated demolition debris would be disposed of in an IDF or consolidated within available below-grade spaces within the RCB or Buildings 491E and 491W. All radioactive and/or hazardous material would be removed. Wood and large steel components would also be removed. Foundation rubble (e.g., concrete and rebar) could remain. The area previously occupied by these facilities would be backfilled with soil, compacted, contoured, and revegetated. As indicated in Appendix E, Table E–14, some of these buildings would be either completely or partially within the footprint (including the side slope) of the engineered barrier over the RCB.

D.2.3.2 Process Components

The reactor vessel, piping systems, and tanks located above grade within the RCB and immediately adjacent buildings would be dismantled and placed in below-grade spaces, as practicable, or transported to an IDF for disposal. Deactivation activities would be complete, including draining of the bulk sodium and removal of SNF, lead shielding, remote-handled special components, small-bore piping, valves, and other components. Systems located below grade (including regulated waste) would be grouted in place after treatment of any SNF sodium residuals. The small-diameter (less than 20.3 centimeters [8 inches]) piping would be removed, treated (cleaned of sodium) in the 400 Area, and disposed of on site in an IDF or placed in below-grade spaces within the RCB.

D.2.3.3 Sodium Residuals

All sodium residuals would be removed from the RCB systems or treated in place. It was assumed that sodium would be drained from plant systems to the extent practicable, followed by moist gas passivation and/or flushing with water to stabilize sodium residuals. Sodium residuals in small-diameter piping would be treated in the 400 Area after removal of the components from the reactor plant.

D.2.3.4 Demolition and Other Waste

Demolition debris from facility decommissioning (chemically hazardous or radioactive solid waste) would be handled in the same way under both action alternatives, except that the disposition of the volumes of debris would change. Under FFTF Decommissioning Alternative 2, the debris not placed in the RCB or other voids or used as backfill would be transported to an IDF for disposal. Solid waste resulting from any of the processing options (for sodium residual waste, bulk sodium, etc.) would be included with the analyses of those options.

Radioactive liquid waste resulting from treatment of the sodium residuals also would be handled in the same way under both action alternatives. The liquid volume would be reduced at FFTF (through either ion exchange and reuse or evaporation), and the remaining liquids would be transported to the 200 Area ETF for processing and disposal. For the analyses in this *TC & WM EIS*, it was assumed that a 90 percent reduction in volume could be achieved prior to shipment of the liquid to the ETF for processing. Any other sources of radioactive waste (such as decontamination solutions) are expected to result in very small volumes compared with waste produced as a result of treating sodium residuals.

Other regulated waste, such as PCBs, asbestos, and nonradioactive hazardous waste, would be handled in a similar manner under all of the alternatives. The volume of this waste is expected to be small, and it would be disposed of in accordance with existing *Hanford Site Solid Waste Acceptance Criteria* (Fluor Hanford 2005b) or offsite treatment contracts.

D.2.3.5 End State

For analysis in this *TC & WM EIS*, it was assumed that a modified RCRA Subtitle C barrier would be constructed over the RCB and Buildings 491E and 491W, which contain residual radioactive and/or hazardous waste.

In addition, the barrier would extend over part or all of the immediately adjacent facility footprints. The barrier would be circular with a radius of about 39.2 meters (128.5 feet), not including the side slope used for drainage. The side slope would be about 5.2 meters (17.1 feet) using a 3 horizontal:1 vertical slope. Minimal postclosure care would be required. The remainder of the PPA would be backfilled with soil, compacted, recontoured, and revegetated.

The modified RCRA Subtitle C barrier would be designed to provide containment and hydrologic protection for a performance period of 500 years. This performance period is conservatively based on radionuclide concentration and activity limits for Category 3 low-level radioactive waste (LLW). The modified RCRA Subtitle C barrier would be composed of eight layers of durable material with a combined minimum thickness of about 1.7 meters (5.7 feet), excluding the grading fill layer, which would range from zero at the edge to approximately 0.8 meters (2.6 feet) at the center for a 2 percent drainage slope. The design would also incorporate an asphaltic concrete layer to reduce the likelihood of bio-intrusion or inadvertent human intrusion (SAIC 2010b). Further information on the modified RCRA Subtitle C barrier can be found in Appendix E, Section E.1.2.5.4.1.

Matching the list of radionuclides and chemicals identified in Tables D–74 through D–77 with the COPCs identified in Section D.1.1, resulted in a report of the following radionuclides (in curies): cesium-137, carbon-14, tritium, and technetium-99, as well as the following chemicals (in kilograms): chromium, lead, and uranium. Table D–80 is a summary of each of the radioactive and chemical COPCs under FFTF Decommissioning Alternative 2.

Table D–80. FFTF Decommissioning Alternative 2 Radioactive and Chemical Constituents of Potential Concern Balance

	Cesium-137	Carbon-14	Hydrogen-3 (Tritium)	Technetium-99	Chromium	Lead	Total Uranium
	Curies				Kilograms		
Inventory Remaining at the FFTF Site							
Hardware[a]	0	5.24×10^{1}	0	2.72×10^{1}	0	0	3.77×10^{4}
Bioshield	0	7.65×10^{-4}	1.73×10^{-5}	4.52×10^{-6}	0	0	0
Total remaining inventory	**0**	**5.24×10^{1}**	**1.73×10^{-5}**	**2.72×10^{1}**	**0**	**0**	**3.77×10^{4}**
Inventory Disposed of in an IDF							
Sodium residuals[b]	1.43×10^{-3}	0	2.29	0	5.72×10^{-3}	4.30×10^{-3}	2.86×10^{-2}
Secondary waste[c]	1.43×10^{-3}	6.33×10^{-4}	3.58×10^{-7}	1.48×10^{-2}	1.79×10^{-3}	1.34×10^{-3}	4.09×10^{-3}
Total inventory disposed of in an IDF	**2.86×10^{-3}**	**6.33×10^{-4}**	**2.29**	**1.48×10^{-2}**	**7.50×10^{-3}**	**5.64×10^{-3}**	**3.27×10^{-2}**

[a] Hardware includes activated reactor hardware, the depleted uranium shield, core components, nonfueled hardware, and Interim Examination and Maintenance Cell items.

[b] The inventory for the approximately 15,142 liters (4,000 gallons) of sodium residuals includes FFTF components, e.g., the reactor and miscellaneous traps.

[c] Secondary-waste inventories were estimated from 2006 *Solid Waste Integrated Forecast Technical (SWIFT) Report, FY2006–FY2035* database information (Barcot 2005). For analysis purposes, it was conservatively assumed that 100 percent of the cesium-137 inventory would be captured in the secondary waste.

Note: To convert kilograms to pounds, multiply by 2.2046.

Key: FFTF=Fast Flux Test Facility; IDF=Integrated Disposal Facility.

Source: SAIC 2011.

D.2.4 FFTF Decommissioning Alternative 3: Removal

Under this alternative, the portions of the RCB (and structures within) that are above grade level would be decontaminated as necessary, dismantled, and removed. All sodium residuals would be removed from the RCB or treated in place to neutralize the chemical reactivity of the metallic sodium. Below grade level, the reactor vessel and contaminated reactor vessel internals, other radioactively contaminated equipment, piping, materials, and other components, along with any asbestos, depleted uranium shielding, and lead shielding, would also be removed. Such radioactively contaminated equipment, piping, materials, and components would include the intermediate heat exchangers, primary pumps, primary isolation valves, primary overflow tanks, IEM Cell equipment, 8.5- to 12.2-meter (28- to 40-foot) test assembly hardware, and the Interim Decay Storage Vessel. Additional radioactively contaminated equipment from the RCB and FFTF heat transport system would also be removed. Upon removal, this equipment would be disposed of in an IDF. The below-grade RCB and the FFTF support buildings outside the RCB area would be decontaminated as necessary and demolished. The area previously occupied by the facilities would then be backfilled with soil, compacted, recontoured, and revegetated. An appropriate monitoring program would also be established. The following sections describe the activities to be conducted under the Removal Alternative.

D.2.4.1 Facility Disposition

All above-grade structures that are part of the RCB and the immediately adjacent support facilities with substructures (basements) would be dismantled, and the contaminated demolition debris would be disposed of in an IDF. The RCB would be demolished down to grade level and the support facilities would be demolished to 0.91 meters (3 feet) below grade. Below-grade radioactively contaminated components and equipment (including the reactor vessel) would be removed. However, the reinforced concrete shell in the RCB would remain and be backfilled with either soil or grout, compacted, recontoured, and revegetated. Small amounts of radioactive activation products in structural concrete and steel would remain. All small-diameter piping would be removed, and sodium residuals would be either treated in place or removed from the RCB for treatment at an onsite facility to neutralize the chemical reactivity of the metallic sodium.

All other ancillary buildings, including their internal equipment and components, would be demolished and removed (down to a depth of 0.91 meters [3 feet] below grade). The contaminated demolition debris would be disposed of in an IDF, and the vacated spaces would be backfilled, compacted, recontoured, and revegetated. All radioactive and/or hazardous material would be removed. Wood and large steel components would also be removed. Foundation rubble, e.g., concrete and rebar, would remain.

D.2.4.2 Process Components

The above- and below-grade reactor vessel, piping systems, and tanks within the RCB and the immediately adjacent buildings would be dismantled and transported to an IDF for disposal. Deactivation activities would be completed, including draining of the bulk sodium and removal of SNF, lead shielding, remote-handled special components, small-bore piping, valves, and other components. Radioactively contaminated equipment, piping, tanks, hazardous materials (including asbestos and lead shielding), and other components would also be removed for disposal in an IDF. The reactor vessel (along with any attached depleted uranium shielding and/or internal piping and equipment) would be filled with grout, removed, packaged, and transported to an IDF for disposal. Uncontaminated material (i.e., material that is clean of radioactive or hazardous substances) would not be removed and, as previously stated, the reinforced concrete shell would remain. All small-diameter piping would be removed. The small-diameter piping would be treated in the 400 Area to remove sodium residuals and would be disposed of on site in an IDF.

D.2.4.3 Sodium Residuals

Sodium residuals would be treated the same under both FFTF Decommissioning action alternatives. All sodium residuals would be removed from the RCB systems or treated in place. It was assumed that sodium would be drained from the plant systems to the extent practicable, followed by moist gas passivation and/or flushing with water to stabilize sodium residuals. Sodium residuals in small-diameter piping would be treated in the 400 Area after the piping has been removed from the reactor plant.

D.2.4.4 Demolition and Other Waste

Demolition debris, radioactive solid waste, radioactive liquid waste, and other regulated hazardous waste would be handled in the same manner under both FFTF Decommissioning action alternatives; only the disposition of the volume of waste would change. The approaches to waste handling also would be the same, and demolition waste would be disposed of in an IDF under both action alternatives.

D.2.4.5 End State

Below-grade portions of structures would be backfilled with soil, compacted, recontoured, and revegetated. Although there would be no anticipated need for an engineered barrier, it was assumed for analysis purposes that an appropriate postclosure care program would be established (SAIC 2010b).

Matching the list of radionuclides and chemicals identified in the previous tables with the COPCs identified in Section D.1.1 resulted in a report of the following radionuclides (in curies): cesium-137, carbon-14, tritium, and technetium-99, as well as the following chemicals (in kilograms): chromium, lead, and uranium. Table D–81 is a summary of each of the radioactive and chemical COPCs under FFTF Decommissioning Alternative 3.

Table D–81. FFTF Decommissioning Alternative 3 Radioactive and Chemical Constituents of Potential Concern Balance

	Cesium-137	Carbon-14	Hydrogen-3 (Tritium)	Technetium-99	Chromium	Lead	Total Uranium
	Curies				Kilograms		
Inventory Remaining at the FFTF Site							
Bioshield	0	7.65×10^{-4}	1.73×10^{-5}	4.52×10^{-6}	0	0	0
Inventory Disposed of in an IDF							
Sodium residuals[a]	1.43×10^{-3}	0	2.29	0	5.72×10^{-3}	4.30×10^{-3}	2.86×10^{-2}
Hardware[b]	0	5.24×10^{1}	0	2.72×10^{1}	0	0	3.77×10^{4}
Secondary waste[c]	1.43×10^{-3}	6.41×10^{-4}	1.27×10^{-6}	1.50×10^{-2}	1.81×10^{-3}	1.36×10^{-3}	1.36×10^{-2}
Total Inventory Disposed of in an IDF	**2.86×10^{-3}**	**5.24×10^{1}**	**2.29**	**2.72×10^{1}**	**7.52×10^{-3}**	**5.65×10^{-3}**	**3.77×10^{4}**

[a] The inventory for the approximately 15,142 liters (4,000 gallons) of sodium residuals includes FFTF components, e.g., the reactor and miscellaneous traps.

[b] Hardware includes activated reactor hardware, the depleted uranium shield, core components, nonfueled hardware, and Interim Examination and Maintenance Cell items.

[c] Secondary-waste inventories were estimated from 2006 *Solid Waste Integrated Forecast Technical (SWIFT) Report, FY2006–FY2035* database information (Barcot 2005). For analysis purposes, it was conservatively assumed that 100 percent of the cesium-137 inventory would be captured in the secondary waste.

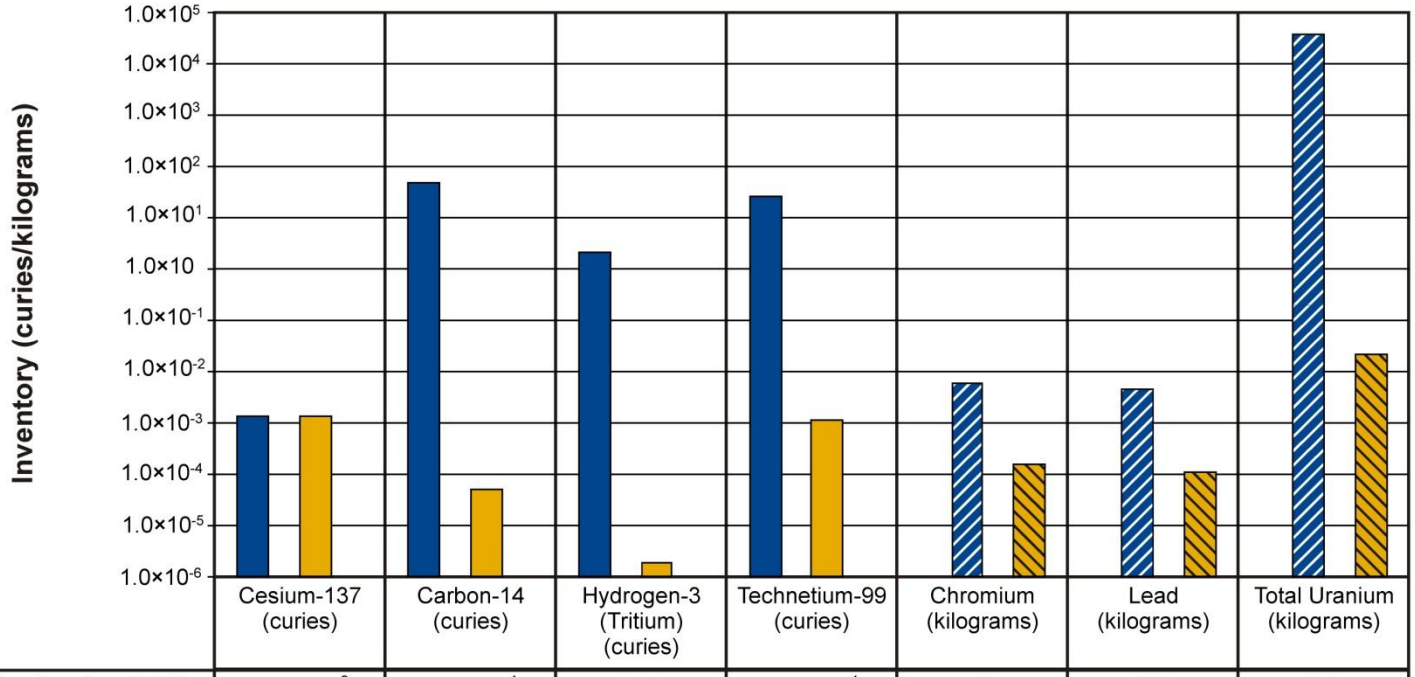
Note: To convert kilograms to pounds, multiply by 2.2046.

Key: FFTF=Fast Flux Test Facility; IDF=Integrated Disposal Facility.

Source: SAIC 2011.

D.2.5 Distribution of Fast Flux Test Facility Waste

As discussed above, under each of the three FFTF Decommissioning alternatives, a number of waste streams would be generated, and this waste would be disposed of differently. This section provides histograms (see Figures D–64, D–65, and D–66) depicting the distribution of the radioactive COPCs between the FFTF site and an IDF under each of the FFTF Decommissioning alternatives (SAIC 2011). The COPCs shown include both radionuclides (cesium-137, carbon-14, tritium, and technetium-99) and chemicals (chromium, lead, and total uranium).



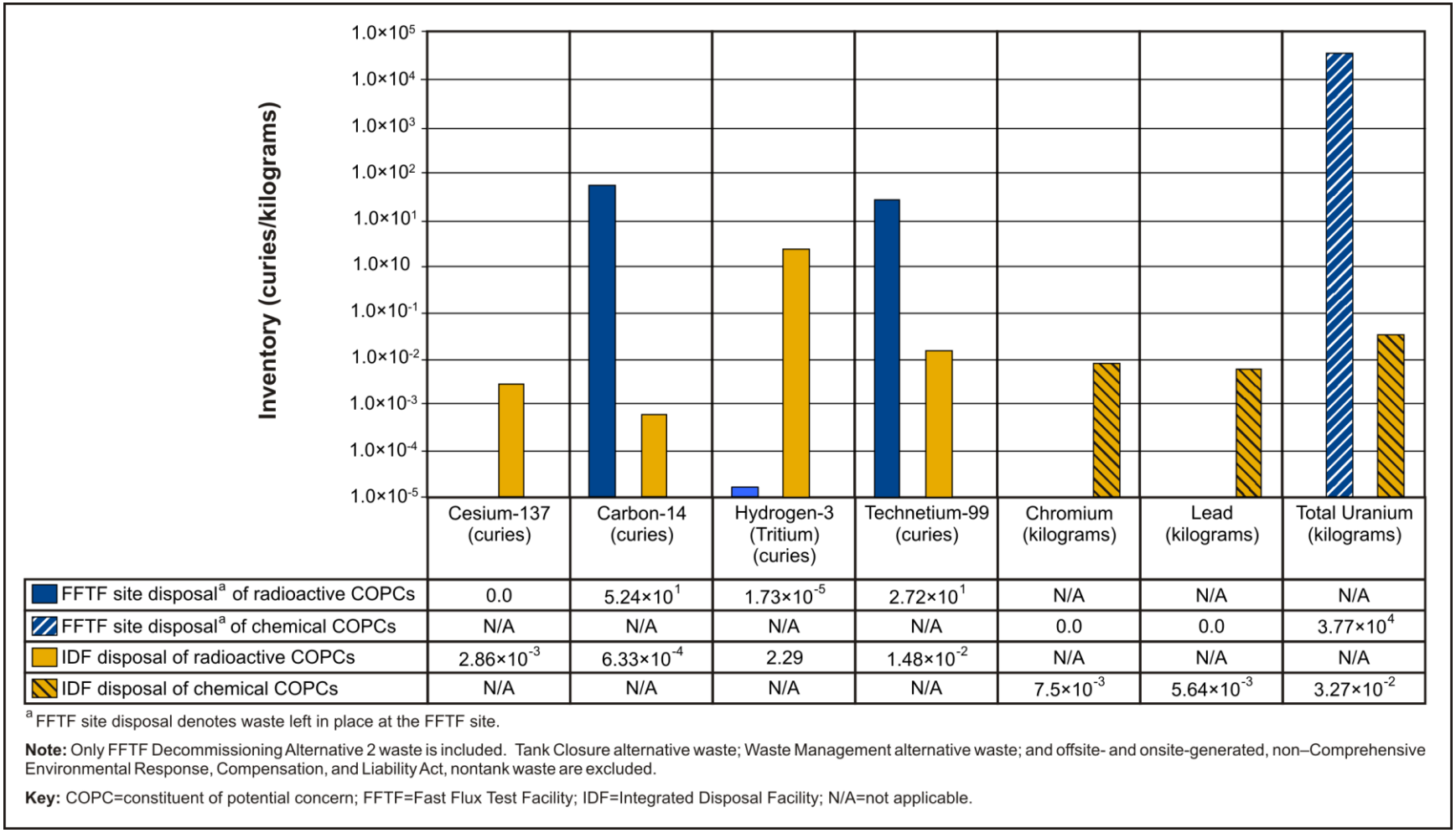
	Cesium-137 (curies)	Carbon-14 (curies)	Hydrogen-3 (Tritium) (curies)	Technetium-99 (curies)	Chromium (kilograms)	Lead (kilograms)	Total Uranium (kilograms)
FFTF site disposal[a] of radioactive COPCs	1.43×10^{-3}	5.24×10^{1}	2.29	2.72×10^{1}	N/A	N/A	N/A
FFTF site disposal[a] of chemical COPCs	N/A	N/A	N/A	N/A	5.72×10^{-3}	4.3×10^{-3}	3.77×10^{4}
Trenches disposal of radioactive COPCs	1.43×10^{-3}	5.31×10^{-5}	1.88×10^{-6}	1.19×10^{-3}	N/A	N/A	N/A
Trenches disposal of chemical COPCs	N/A	N/A	N/A	N/A	1.42×10^{-4}	1.07×10^{-4}	2.14×10^{-2}

[a] FFTF site disposal denotes waste left in place at the FFTF site.

Note: Only FFTF Decommissioning Alternative 1 waste is included. Tank Closure alternative waste; Waste Management alternative waste; and offsite- and onsite-generated, non–Comprehensive Environmental Response, Compensation, and Liability Act, nontank waste are excluded.

Key: COPC=constituent of potential concern; FFTF=Fast Flux Test Facility; N/A=not applicable.

Figure D–64. FFTF Decommissioning Alternative 1 Distribution of Radioactive and Chemical Constituents of Potential Concern



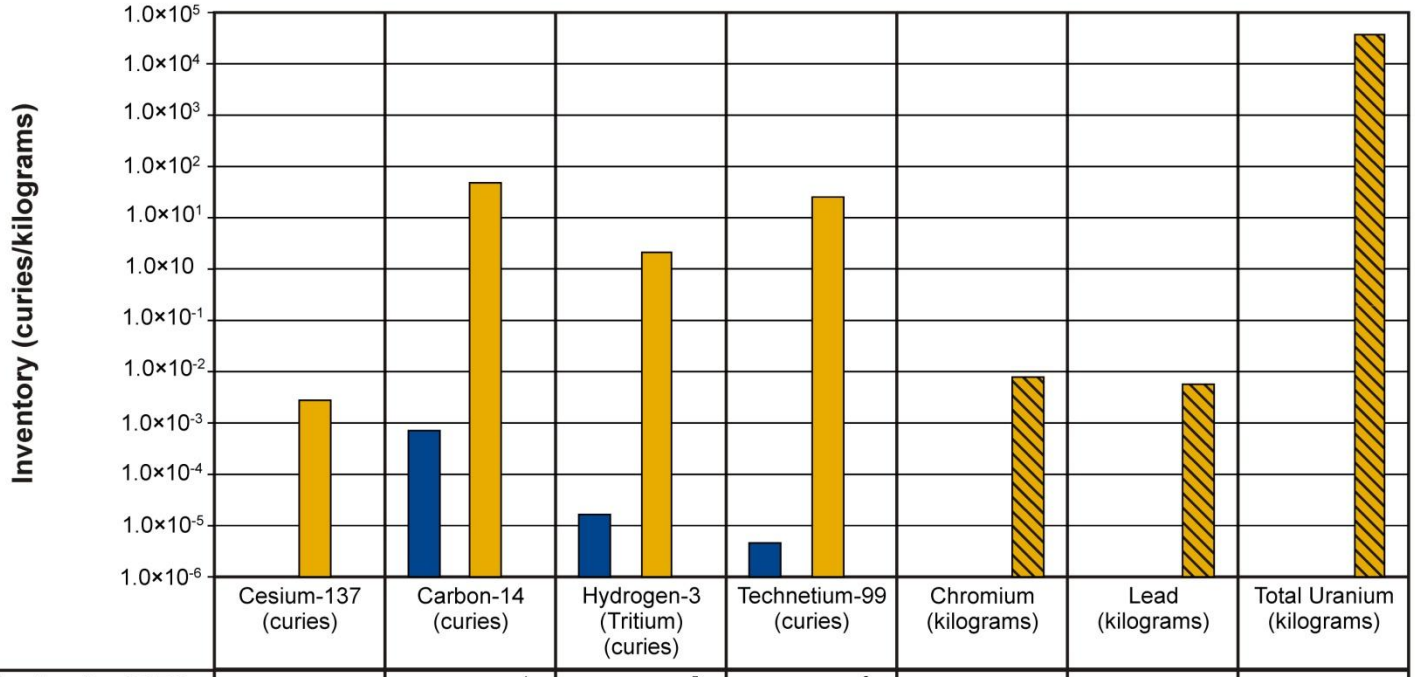
	Cesium-137 (curies)	Carbon-14 (curies)	Hydrogen-3 (Tritium) (curies)	Technetium-99 (curies)	Chromium (kilograms)	Lead (kilograms)	Total Uranium (kilograms)
FFTF site disposal[a] of radioactive COPCs	0.0	5.24×10^{1}	1.73×10^{-5}	2.72×10^{1}	N/A	N/A	N/A
FFTF site disposal[a] of chemical COPCs	N/A	N/A	N/A	N/A	0.0	0.0	3.77×10^{4}
IDF disposal of radioactive COPCs	2.86×10^{-3}	6.33×10^{-4}	2.29	1.48×10^{-2}	N/A	N/A	N/A
IDF disposal of chemical COPCs	N/A	N/A	N/A	N/A	7.5×10^{-3}	5.64×10^{-3}	3.27×10^{-2}

[a] FFTF site disposal denotes waste left in place at the FFTF site.

Note: Only FFTF Decommissioning Alternative 2 waste is included. Tank Closure alternative waste; Waste Management alternative waste; and offsite- and onsite-generated, non–Comprehensive Environmental Response, Compensation, and Liability Act, nontank waste are excluded.

Key: COPC=constituent of potential concern; FFTF=Fast Flux Test Facility; IDF=Integrated Disposal Facility; N/A=not applicable.

Figure D–65. FFTF Decommissioning Alternative 2 Distribution of Radioactive and Chemical Constituents of Potential Concern



	Cesium-137 (curies)	Carbon-14 (curies)	Hydrogen-3 (Tritium) (curies)	Technetium-99 (curies)	Chromium (kilograms)	Lead (kilograms)	Total Uranium (kilograms)
FFTF site disposal[a] of radioactive COPCs	0.0	7.65×10^{-4}	1.73×10^{-5}	4.52×10^{-6}	N/A	N/A	N/A
FFTF site disposal[a] of chemical COPCs	N/A	N/A	N/A	N/A	0.0	0.0	0.0
IDF disposal of radioactive COPCs	2.86×10^{-3}	5.24×10^{1}	2.29	2.72×10^{1}	N/A	N/A	N/A
IDF disposal of chemical COPCs	N/A	N/A	N/A	N/A	7.52×10^{-3}	5.65×10^{-3}	3.77×10^{4}

[a] FFTF site disposal denotes waste left in place at the FFTF site.

Note: Only FFTF Decommissioning Alternative 3 waste is included. Tank Closure alternative waste; Waste Management alternative waste; and offsite- and onsite-generated, non–Comprehensive Environmental Response, Compensation, and Liability Act, nontank waste are excluded.

Key: COPC=constituent of potential concern; FFTF=Fast Flux Test Facility; IDF=Integrated Disposal Facility; N/A=not applicable.

Figure D–66. FFTF Decommissioning Alternative 3 Distribution of Radioactive and Chemical Constituents of Potential Concern

D.3 WASTE MANAGEMENT ALTERNATIVES

D.3.1 Radionuclide and Chemical Inventories

This section summarizes the radionuclide and chemical inventories analyzed for each of the three Waste Management alternatives. Appendix E, Section E.3.1, provides a summary description of the Waste Management alternatives analyzed in this *TC & WM EIS* and is partially reproduced in this section for the reader's convenience. Within the Waste Management alternatives, only three waste generators were identified for inclusion in the *TC & WM EIS* alternatives analyses, as follows:

- Secondary LLW and MLLW from operation of LLBG 218-W-5, trenches 31 and 34
- Secondary LLW and MLLW from operation of the Waste Receiving and Processing Facility (WRAP)
- Secondary LLW and MLLW from operation of the T Plant complex

Operation of an IDF and the RPPDF were estimated to generate insignificant quantities of secondary waste (e.g., workers' personal protective equipment and other contaminated waste materials). Data found for operation of the Central Waste Complex (CWC) concluded that it also generates insignificant quantities of secondary waste (SAIC 2010c). Generators of onsite non-CERCLA, non-tank-activity waste, and offsite waste are identified in Sections D.3.5 and D.3.6, respectively.

D.3.1.1 Assumptions

Assumptions for the Waste Management alternatives include the following:

- Due to uncertainties regarding the future needs of the waste management facilities at Hanford, the scope of the Waste Management alternatives included the assumption that expanded capabilities of the current treatment operations at the T Plant complex, the CWC, and WRAP would be necessary.
- Tank closure activities would generate the following waste streams, which would be disposed of on site in an IDF: ILAW glass; retired LAW melters; bulk vitrification glass; steam reforming waste; cast stone waste; sulfate grout waste; ETF-generated solid secondary waste; other solid secondary waste from tank farm and treatment processes, including treatment of the cesium and strontium capsules; and PPF glass. Rubble, soil, and equipment generated from clean closure activities would be disposed of in the RPPDF.
- Treatment of offsite LLW and MLLW would be completed off site either at the generator site or at a commercial treatment facility prior to shipment to Hanford. Section D.3.6 provides the offsite waste inventories and the basis for the inventory estimates.
- No additional offsite TRU or mixed TRU waste would be received at Hanford.
- Non-CERCLA, nontank LLW and MLLW would be generated at Hanford through 2035. Section D.3.5 provides this inventory and the basis for the inventory estimates.

- For analysis purposes, continued operation of LLBG 218-W-5, trenches 31 and 34, was analyzed under the Waste Management alternatives; however, it was assumed that IDF operations would commence in 2009 and that all waste generated that is appropriate for IDF disposal would be disposed of in an IDF.

- Activities proposed under the Tank Closure alternatives were assumed to determine the requirements for the ETF, 242-A Evaporator, and Borrow Area C; therefore, operations and replacement of these facilities were analyzed under the Tank Closure alternatives and not the Waste Management alternatives.

- Packaging and shipment of waste currently stored in a glass or ceramic form (commonly referred to as "German Logs") were not analyzed in this *TC & WM EIS* (SAIC 2010c).

D.3.2 Waste Management Alternative 1: No Action

Under this alternative, storage and treatment of LLW, MLLW, and TRU waste would continue at the CWC, and disposal would continue at LLBG 218-W-5, trenches 31 and 34, until an estimated operational closure date of 2035. Likewise, storage and treatment of onsite LLW, MLLW, and TRU waste would continue at WRAP and the T Plant complex. No shipments of offsite LLW, MLLW, or TRU waste would be accepted. For analysis purposes, it was assumed that construction of the 200-East Area IDF (IDF-East) would be discontinued in 2008 and no closure barriers would be constructed over the disposal trenches and waste treatment facilities. Administrative controls would be maintained for 100 years following operational closure of the disposal trenches.

Table D–82 shows the radioactive and chemical COPC inventories for Waste Management Alternative 1. These inventories would be disposed of in lined trenches 31 and 34 at LLBG 218-W-5.

Table D–82. Waste Management Alternative 1 Inventory[a]

	I-129	Cs-137	C-14	H-3 (Tritium)	U-233, -234, -235, -238	Np-237	Pu-239, -240	Sr-90	Tc-99	Cr	Hg	Pb
	Curies									Kilograms		
Secondary waste[b]	NR	2.39×10^{-3}	NR	NR	NR	NR	NR	1.63×10^{-3}	2.13×10^{-3}	NR	NR	NR

[a] Only three chemicals were reported (nitrate, total uranium, acetonitrile, benzene, butanol [n-butyl alcohol], 2,4,6-trichlorophenol, and polychlorinated biphenyls were not reported).

[b] Secondary waste includes workers' personal protective equipment and other contaminated materials. Disposal would be in Low-Level Radioactive Waste Burial Ground 218-W-5, trenches 31 and 34.

Key: C=carbon; Cr=chromium; Cs=cesium; H=hydrogen; Hg=mercury; I=iodine; Np=neptunium; NR=not reported; Pb=lead; Pu=plutonium; Sr=strontium; Tc=technetium; U=uranium.

Source: SAIC 2011.

D.3.3 Waste Management Alternative 2: Disposal in IDF, 200-East Area Only

Under this alternative, storage and treatment of LLW, MLLW, and TRU waste would continue using both the existing and the proposed expanded capabilities at the CWC, the T Plant complex, and WRAP. Appendix E, Sections E.3.2, E.3.3, and E.3.4, describe in detail the expanded CWC, T Plant complex, and WRAP facilities, respectively. Offsite waste would be limited to 62,000 cubic meters (81,000 cubic yards) of LLW and 20,000 cubic meters (26,000 cubic yards) of MLLW, with reception of shipments estimated to occur from 2010 through 2046. Onsite (Hanford), non-CERCLA, nontank waste would be generated through 2035. For analysis purposes, operation of LLBG 218-W-5, trenches 31 and 34, would continue through 2050. IDF-East would begin operations in 2009. Under this alternative, IDF-East would accept the following waste: tank closure activity waste; FFTF decommissioning waste; waste

management facility-generated (secondary) waste; onsite non-CERCLA, non-tank-activity waste; and offsite waste. A new disposal facility, the RPPDF, would be constructed for disposal of lightly contaminated rubble, soil, and equipment resulting from clean closure of tank farm facilities.

To reduce the combinations of IDF and RPPDF configurations that would require analysis in this *TC & WM EIS*, three disposal groups were developed and analyzed, as follows:

- *Disposal Group 1:* This group supports Tank Closure Alternatives 2B, 3A, 3B, 3C, 4, 5, and 6C; FFTF Decommissioning Alternatives 2 and 3; and Waste Management Alternative 2 for onsite non-CERCLA, non-tank-activity waste and offsite waste. Both IDF-East and the RPPDF would operate through 2050, with capacities of 1.2 million cubic meters (1.57 million cubic yards) and 1.08 million cubic meters (1.41 million cubic yards), respectively.

- *Disposal Group 2:* This group supports Tank Closure Alternatives 2A and 6B, both Base and Option Cases; FFTF Decommissioning Alternatives 2 and 3; and Waste Management Alternative 2 for onsite non-CERCLA, non-tank-activity waste and offsite waste. Both IDF-East and the RPPDF would operate through 2100, with capacities of 425,000 cubic meters (556,000 cubic yards) and 8.37 million cubic meters (10.9 million cubic yards), respectively.

- *Disposal Group 3:* This group supports Tank Closure Alternative 6A, Base and Option Cases; FFTF Decommissioning Alternatives 2 and 3; and Waste Management Alternative 2 for onsite non-CERCLA, non-tank-activity waste, and offsite waste. Both IDF-East and the RPPDF would operate through 2165, with capacities of 425,000 cubic meters (556,000 cubic yards) and 8.37 million cubic meters (10.9 million cubic yards), respectively.

Table D–83 shows the radioactive and chemical COPC inventories for Waste Management Alternatives 2 and 3 (discussed below). Under Waste Management Alternative 2, disposal of these inventories would occur in IDF-East.

Table D–83. Waste Management Alternatives 2 and 3 Radioactive and Chemical Constituents of Potential Concern Balance[a]

	I-129	Cs-137	C-14	H-3 (Tritium)	U-233, -234, -235, -238	Np-237	Pu-239, -240	Sr-90	Tc-99	Cr	Hg	Pb
	Curies									Kilograms		
Secondary waste[b]	1.43×10^{-5}	1.04	4.04×10^{-5}	3.03×10^{1}	1.05×10^{-3}	6.17×10^{-6}	1.86	6.28	9.95×10^{-2}	1.39×10^{1}	2.29	2.32×10^{2}

[a] Only three chemicals were reported (nitrate, total uranium, acetonitrile, benzene, butanol [n-butyl alcohol], 2,4,6-trichlorophenol, and polychlorinated biphenyls were not reported).

[b] Secondary waste includes workers' personal protective equipment and other contaminated materials, as well as Waste Receiving and Processing Facility and T Plant complex low-level radioactive waste and mixed low-level radioactive waste, which would be disposed of in an Integrated Disposal Facility in the 200-East Area under Waste Management Alternative 2 and in the 200-West Area under Waste Management Alternative 3.

Note: To convert kilograms to pounds, multiply by 2.2046.

Key: C=carbon; Cr=chromium; Cs=cesium; H=hydrogen; Hg=mercury; I=iodine; Np=neptunium; Pb=lead; Pu=plutonium; Sr=strontium; Tc=technetium; U=uranium.

Source: SAIC 2011.

D.3.4 Waste Management Alternative 3: Disposal in IDF, 200-East and 200-West Areas

Under this alternative, activities would be the same as those under Waste Management Alternative 2, except disposal of the waste would be split between IDF-East and a new IDF site in the 200-West Area (IDF-West). Except for the waste from tank closure activities, all of the waste streams discussed under

Waste Management Alternative 2 would be disposed of in IDF-West. Only the tank closure waste would be disposed of in IDF-East.

The three disposal groups under Waste Management Alternative 3 are as follows:

- *Disposal Group 1:* This group supports Tank Closure Alternatives 2B, 3A, 3B, 3C, 4, 5, and 6C; FFTF Decommissioning Alternatives 2 and 3; and Waste Management Alternative 3 for onsite non-CERCLA, non-tank-activity waste and offsite waste. IDF-East would have a capacity of 1.1 million cubic meters (1.43 million cubic yards), IDF-West would have a capacity of 90,000 cubic meters (118,000 cubic yards), and the RPPDF would have a capacity of 1.08 million cubic meters (1.41 million cubic yards). All three facilities would operate through 2050.

- *Disposal Group 2:* This group supports Tank Closure Alternatives 2A and 6B, both Base and Option Cases; FFTF Decommissioning Alternatives 2 and 3; and Waste Management Alternative 3 for onsite non-CERCLA, non-tank-activity waste and offsite waste. IDF-East would have a capacity of 340,000 cubic meters (445,000 cubic yards), IDF-West would have a capacity of 90,000 cubic meters (118,000 cubic yards), and the RPPDF would have a capacity of 8.37 million cubic meters (10.9 million cubic yards). IDF-East and the RPPDF would operate through 2100. IDF-West would operate through 2050.

- *Disposal Group 3:* This group supports Tank Closure Alternative 6A, Base and Option Cases; FFTF Decommissioning Alternatives 2 and 3; and Waste Management Alternative 3 for onsite non-CERCLA, non-tank-activity waste and offsite waste. IDF-East would have a capacity of 340,000 cubic meters (445,000 cubic yards), IDF-West would have a capacity of 90,000 cubic meters (118,000 cubic yards), and the RPPDF would have a capacity of 8.37 million cubic meters (10.9 million cubic yards). IDF-East and the RPPDF would operate through 2165. IDF-West would operate through 2050.

Table D–83 shows the radioactive and chemical COPC inventories for Waste Management Alternatives 2 (discussed above) and 3. Under Waste Management Alternative 3, disposal of these inventories would occur in IDF-West.

D.3.5 Radionuclide and Chemical Inventory Estimates for Onsite Non-CERCLA, Non-Tank-Activity Waste

This section summarizes the non-CERCLA, non-tank-waste-related radioactive and chemical waste inventories that would be generated at Hanford. Examples of facilities and operations that are expected to generate such waste include the Plutonium Finishing Plant; the T Plant complex; the Waste Encapsulation and Storage Facility; WRAP; the Waste Sampling and Characterization Facility; groundwater sampling activities; Pacific Northwest National Laboratory; the Cold Vacuum Drying Facility; the Canister Storage Building; and the Liquid Waste Processing Facilities, which include the Liquid Effluent Retention Facility, the ETF, the State-Approved Land Disposal Site, and the Treated Effluent Disposal Facility.

Estimates of the radionuclide and chemical inventories for the above sources were developed from the Hanford *Solid Waste Integrated Forecast Technical (SWIFT) Report, FY2006–FY2035* database (Barcot 2005). From this source, the volume of LLW and MLLW for the period 2006 through 2035 was estimated to be approximately 5,300 cubic meters (6,930 cubic yards) (SAIC 2011).

Table D–84 is a summary of the radioactive COPC inventory for the onsite non-CERCLA, non-tank-activity waste. Table D–85 is a summary of the chemical COPC inventory for the onsite non-CERCLA, non-tank-activity waste.

Table D–84. Onsite Non-CERCLA, Non-Tank-Activity Waste Radioactive Constituents of Potential Concern Inventory[a]

	Iodine-129	Cesium-137	Carbon-14	Hydrogen-3 (Tritium)	Uranium-233, -234,-235,-238	Neptunium-237	Plutonium-239, -240	Strontium-90	Technetium-99
	Curies								
CH- and RH-LLW	9.98×10^{-5}	1.36×10^{3}	8.17×10^{-1}	2.68×10^{3}	2.24×10^{-1}	4.38×10^{-5}	4.22	1.75×10^{3}	7.95×10^{-1}
CH- and RH-MLLW	1.22×10^{-3}	1.35×10^{3}	6.88×10^{-3}	8.28×10^{2}	5.12×10^{-1}	7.33×10^{-3}	3.81	1.73×10^{3}	4.17×10^{-1}
Total	**1.32×10^{-3}**	**2.71×10^{3}**	**8.24×10^{-1}**	**3.51×10^{3}**	**7.36×10^{-1}**	**7.37×10^{-3}**	**8.03**	**3.48×10^{3}**	**1.21**

[a] Onsite generators only, including the Plutonium Finishing Plant, T Plant complex, Waste Encapsulation and Storage Facility, Waste Receiving and Processing Facility, Waste Sampling and Characterization Facility, groundwater sampling activities, Pacific Northwest National Laboratory, Cold Vacuum Drying Facility, Canister Storage Building, and Liquid Waste Processing Facilities (Liquid Effluent Retention Facility, Effluent Treatment Facility, State-Approved Land Disposal Site, and Treated Effluent Disposal Facility).

Key: CERCLA=Comprehensive Environmental Response, Compensation, and Liability Act; CH=contact-handled; LLW=low-level radioactive waste; MLLW=mixed low-level radioactive waste; RH=remote-handled.

Source: SAIC 2011.

Table D–85. Onsite Non-CERCLA, Non-Tank-Activity Waste Chemical Constituents of Potential Concern Inventory[a]

	Acetonitrile	Arsenic (As)	Benzene	Boron (B)	Butanol (N-butyl Alcohol)	Cadmium (Cd)	Chromium (Cr)	Fluorine (Fl)	Lead (Pb)	Manganese (Mn)	Mercury (Hg)	Molybdenum (Mo)	Nickel (Ni)	Nitrate (NO_3)	PCBs	Silver (Ag)	Strontium (Sr)	Total Uranium (U)	2,4,6-Trichlorophenol
	Kilograms																		
CH- and RH-MLLW	3.91	6.70	1.02	3.66	1.39×10^{-3}	4.95×10^{1}	1.80×10^{2}	2.74×10^{2}	2.58×10^{4}	4.76×10^{1}	8.99×10^{1}	9.39×10^{-5}	1.97	2.97×10^{3}	2.50×10^{1}	7.80×10^{1}	3.13	9.48×10^{-1}	NR

[a] Onsite generators only, including the Plutonium Finishing Plant, T Plant complex, Waste Encapsulation and Storage Facility, Waste Receiving and Processing Facility, Waste Sampling and Characterization Facility, groundwater sampling activities, Pacific Northwest National Laboratory, Cold Vacuum Drying Facility, Canister Storage Building, and Liquid Waste Processing Facilities (Liquid Effluent Retention Facility, Effluent Treatment Facility, State-Approved Land Disposal Site, and Treated Effluent Disposal Facility).

Note: To convert kilograms to pounds, multiply by 2.2046.

Key: CERCLA=Comprehensive Environmental Response, Compensation, and Liability Act; CH=contact-handled; MLLW=mixed low-level radioactive waste; NR=not reported; PCB=polychlorinated biphenyl; RH=remote-handled.

Source: SAIC 2011.

D.3.6 Projected Volumes, Radionuclide and Chemical Inventories for Offsite Waste

As part of DOE's January 6, 2006, Settlement Agreement with the State of Washington (as amended on June 5, 2008) regarding *State of Washington v. Bodman* (Civil No. 2:03-cv-05018-AAM), signed by DOE, Ecology, the Washington State Attorney General's Office, and the U.S. Department of Justice, this *TC & WM EIS* evaluated the transportation of LLW and MLLW from other DOE sites to Hanford for disposal. The volume of this offsite waste was established in the "Record of Decision for the Solid Waste Program, Hanford Site, Richland, WA: Storage and Treatment of Low-Level Waste and Mixed Low-Level Waste; Disposal of Low-Level Waste and Mixed Low-Level Waste, and Storage, Processing, and Certification of Transuranic Waste for Shipment to the Waste Isolation Pilot Plant" (69 FR 39449). The volumes are limited to 62,000 cubic meters (81,100 cubic yards) of LLW and 20,000 cubic meters (26,200 cubic yards) of MLLW. This volume was determined to be a reasonable starting point and followed the 2006 Settlement Agreement and its associated Memorandum of Understanding between DOE and Ecology, and was reflected in the 2006 Notice of Intent (71 FR 5655). The Preferred Alternative for waste management in the *Draft* and this *Final TC & WM EIS* also included limitations on, and exemptions for, offsite waste importation at Hanford, at least until the WTP is operational.

The DOE Office of River Protection and the *TC & WM EIS* team, in coordination with the DOE Office of Environmental Management, developed a report, *Analysis of Offsite-Generated Waste Projections, "Tank Closure and Waste Management Environmental Impact Statement for the Hanford Site,"* dated July 13, 2006 (DOE 2006b), which documents the methodology and analysis related to offsite LLW and MLLW potentially requiring disposal at Hanford. The following is an excerpt from this report (DOE 2006b), followed by a summary of the projected waste characteristics, volumes, and radionuclide and chemical inventories. Offsite waste is analyzed under Waste Management Alternatives 2 and 3 only. It was assumed that no offsite waste would be accepted under Waste Management Alternative 1: No Action.

BACKGROUND

The Hanford Site hosts one of two regional disposal facilities for the Department of Energy's (DOE) low-level radioactive waste (LLW) and mixed LLW (MLLW) resulting from a February 2000 Record of Decision on the *Waste Management Programmatic Environmental Impact Statement* (*WM PEIS*). The *Hanford Solid Waste Environmental Impact Statement* (2004) is the site-specific National Environmental Policy Act document that analyzed specific impacts resulting from disposal of onsite- and offsite-generated LLW and MLLW at Hanford. In January 2006, as a result of a settlement agreement with the State of Washington, the DOE agreed to prepare a new, expanded, comprehensive environmental impact statement (EIS) that combines the scope of the 2004 *Solid Waste EIS* and the developing *TC & WM EIS*. The Environmental Management (EM) Office of Disposal Operations, formerly the Office of Commercial Disposition Options, was asked to compile offsite-generated waste data as input to this new EIS. Waste data, e.g., projected waste volumes, radionuclide inventories, and hazardous chemical constituents are needed for analysis of impacts to humans and the environment within the EIS.

The information needed for the EIS was not readily available, so efforts were undertaken to use existing corporate information, supplemented by information from DOE waste managers. The EM program has corporate performance metrics that capture the actual and projected volume of LLW and MLLW for disposal from "baselined" projects. The information was not sufficiently detailed for modeling purposes, e.g. LLW and MLLW are combined, and data on radionuclide or hazardous chemical constituents is not collected and maintained corporately.

Waste volume projections and "disposition maps" were developed for the EM program in 1999 and 2000 as part of the EM Integration Project. At that time the EM Corporate Information System (Integrated Planning, Accountability, and Budgeting System or IPABS) was developed, including a "stream disposition data" module that provided detail on where individual waste streams were treated and disposed. Largely because of the resource requirements to supply and maintain the stream disposition data, EM management decided to forgo collection of waste volume information at the stream level as a corporate performance metric, in favor of waste volume disposed at the site or project level. Disposition maps, which schematically showed waste streams both within a site and between sites, were not produced between 2001 and 2005.

Due to various program planning needs associated with waste disposition, the Office of Commercial Disposition Options developed a new complex-wide LLW and MLLW data set and new, simplified disposition maps. The data requirements were significantly streamlined with the assistance of EM and other DOE waste managers. A new data collection module was constructed in September 2005, and data was compiled in late 2005 and early 2006. This data was readily available for analysis. Since the new data reflects only currently planned activities within EM, additional information was required to forecast LLW and MLLW that might be sent to Hanford from all offsite sources, e.g., unplanned EM projected waste volumes and waste from other DOE programs.

LLW and MLLW is generated at numerous DOE sites across the complex. Most of the volume of LLW and MLLW is generated from cleanup projects, versus ongoing operations. Over the past several years waste inventories that had been historically stored waiting for treatment and disposal, often called "legacy waste," have nearly all been disposed due to contract incentives aimed at reducing life-cycle waste management infrastructure and costs. Estimates of potential, future offsite generated LLW and MLLW volumes requiring disposal in DOE regional disposal facilities are comprised primarily of waste generated in cleanup and decommissioning projects, rather than legacy waste. Much of this work is yet to be planned. Therefore, there are significant uncertainties in waste volume projections because waste is yet to be generated, and little characteristic information is available as previously discussed. This is a change from the situation during the early years of the EM program when most MLLW was in storage awaiting treatment and disposition.

In addition to uncertainties in waste volume, the newly collected LLW and MLLW waste data did not include radionuclide or hazardous chemical data needed for EIS modeling. EM has not collected radionuclide and hazardous constituent information since the 1990's, when data was collected to support the Federal Facilities Task Force and the *WM PEIS* development. Documented information on radionuclides is found in the *Low-Level Waste Capacity Report*, Revision 2, produced in 2000. This document continues to serve as a source for waste characteristics.

It is difficult to predict the radionuclide and hazardous chemical composition of waste projected in the future, particularly from cleanup programs, because the waste does not exist until the cleanup work progresses. Forecasts are based on best available characterization of the site or facility, the technology selected for cleanup, and the work plans. For this reason, the forecast waste characteristics data in most instances relies on representative information from similar waste streams recently sent to disposal. Actual LLW and MLLW disposal profiles were requested from waste managers and several were judged to have the necessary data for modeling and be suitable for projected waste streams. The Rocky Flats Environmental Technology Site was a source of recent waste

profiles for MLLW, one of which covered debris including metals, solvents, and waste requiring macro-encapsulation. The characteristics of this stream were judged be a reasonable representation for radiological and hazardous chemical constituents of MLLW from future cleanup projects.

DISCUSSION

For the purposes of the new consolidated EIS, the volumes of offsite-generated LLW and MLLW in the existing *Hanford Solid Waste EIS* Record of Decision, namely 62,000 cubic meters for LLW and 20,000 cubic meters for MLLW, should continue to be used in the new EIS. These values sufficiently accommodate current projections and include anticipated new projections for sites where significant cleanup activities and operations are not yet fully scoped. Due to the timing of the EIS and the implementation of resulting record of decision, offsite waste forecasts are largely assumed to begin in 2010, so examination of post 2010 waste volume data collected by EM was the starting point of the analysis. The makeup of the waste volume forecast is discussed below and the attached table summarizes the information.

Environmental Management

A high degree of uncertainty exists in how much LLW could be shipped from EM sites to Hanford after 2010. Based on current practices, waste from EM sites without onsite disposal capacity can be expected to utilize both DOE regional and commercial disposal facilities. Only EM sites completing cleanup beyond 2010 are considered in this forecast. Sites that are major EM contributors to EM LLW disposal projections in 2011 to 2035 (over 1,000 cubic meters) are: Idaho National Laboratory (INL), Paducah, and Oak Ridge. Future waste projections from expected decommissioning at Portsmouth and West Valley, and additional work at Paducah have not yet been developed and reported to EM, but must also be considered.

The recently collected planning data includes no EM offsite shipments of LLW and MLLW projected for the Hanford regional disposal facility. It is not surprising that current baselines do not include shipments to Hanford because, due to the current suspension of off-site shipments, EM projects were replanned to utilize alternate sites. About 112,000 cubic meters of LLW are projected to go to the regional disposal site at Nevada Test Site (NTS) between 2011 and 2035. No MLLW is currently proposed to be disposed at NTS after closure of the current facility at the end of 2010. About 11,700 cubic meters of LLW and 900 cubic meters of MLLW were identified as needing a disposal facility to be determined (TBD) after 2010, some of which may be disposed in a commercial facility. DOE policy, economic factors, and waste acceptance criteria are key to waste management decisions. Coincidentally, the 62,000 cubic meters in the *Hanford Solid Waste EIS* Record of Decision equates to about half of the life-cycle LLW projection for offsite disposal for NTS and TBD combined.

West Valley Demonstration Project is at the site of a former commercial reprocessing plant where DOE and the State of New York are responsible for cleanup. West Valley has a site-wide *Decommissioning and Long-Term Stewardship* EIS in preparation, but agreement on the end state has not occurred. Thus, there is no "baselined" scope of work beyond 2010 and no baseline estimate of future waste from West Valley, although a draft EIS is available with a range of waste projections. LLW from West Valley is expected to contain a variety of radionuclides, including transuranics and fission products, and be in a variety of forms. West Valley is expected to produce significant volumes of waste for

offsite disposal between 2010 and 2030 through facility decommissioning activities. Based on discussions with site waste managers and information in the draft EIS, waste volumes associated with Alternative 4, a "delayed in-place" decommissioning were assumed for this forecast. A LLW volume of 12,000 cubic meters was judged to be a reasonable forecast. Although Alternative 4 in the draft EIS does not have an estimate of MLLW volumes, other alternatives indicated that MLLW debris might be generated during decommissioning at West Valley. Due to the distinct possibility of MLLW generation at West Valley, 500 cubic meters of MLLW was judged to be a reasonable forecast. No radiological or hazardous chemical information was available for modeling, so representative information was selected. For LLW, the complex-wide radiological profile in the DOE Capacity Report was selected as representative; for MLLW a representative Rocky Flats debris stream profile with radiological and hazardous chemical data was selected which included metals, solvents, and waste requiring macro-encapsulation.

Idaho National Laboratory (INL) is managed by the Office of Nuclear Energy (NE); however, EM has a large cleanup project that generates waste at that site during the first several years of the period of concern. EM currently operates the low-level waste disposal area for operational LLW and the Idaho CERCLA Disposal Facility for Comprehensive Environmental Response, Cleanup [*sic*; Compensation], and Liability Act (CERCLA) waste at INL. The INL is examining future alternatives for closure of their onsite disposal facility for LLW from operations. Closure may be required to implement the terms of their final remedy decision currently being developed. Closure of this INL disposal facility would require another disposal option for the LLW currently disposed there which is generated by NE, EM, and Naval Reactors; therefore, modeling of a Hanford alternative is appropriate.

The existing NE programs at INL estimated approximately 1,100 cubic meters of remote-handled LLW and approximately 10 cubic meters of MLLW shipped to Hanford after 2010. Because of the proximity of Hanford versus NTS, Hanford disposal would be a logical place for this and other future waste not capable of being disposed of commercially due to higher activity levels (e.g., equivalent of Class B and C commercial LLW). The annual waste quantities are consistent with those reported between 2010 and 2035 to EM's planning data base. After discussions with waste managers at DOE-Idaho Operations, a representative radiological profile for modeling LLW consisting of Test Reactor Area depleted demineralizer resins was used for the radiological characteristics. This is an existing and ongoing post-2010 remote-handled LLW stream disposed of at INL. The same discussions suggested use of an INL MLLW debris waste stream from the INTEC facility for radiological characteristics and tank farm-related waste information for the chemical characteristics for the small MLLW stream.

The INL plans to play a prominent role in development of the Generation IV prototype nuclear reactor, piloting of an Advanced Fuel Cycle Facility, and expansion for the Center of Advanced Energy Studies generating waste far into the future. In addition, some EM MLLW was historically managed as transuranic waste, but when surveyed has a radionuclide concentration of 10 to 100 nanocuries per gram. The forecast includes future new LLW and MLLW streams from INL. No characteristics information is available, but the waste projected between 2010 and 2020 is assumed to be similar to other waste at INL. The existing profile for Test Reactor Area depleted demineralizer resins is appropriate for the LLW stream of 6,500 cubic meters, while the Rocky Flats

radiological and chemical characteristics are representative for the MLLW stream of 6,330 cubic meters.

Portsmouth and Paducah sites are home to large enrichment plants that will be decommissioned after 2010 by the EM program. Significant volumes of waste are expected to be generated and disposed then at DOE and/or commercial disposal facilities. However, no data is available from these projects, because they are in the early design stage and work scope is not yet planned. The forecast includes 6,500 cubic meters of LLW from each site. Portsmouth waste is forecast between 2010 and 2020, while Paducah waste is forecast between 2015 and 2035. No MLLW was assumed from these sites, since the waste is largely debris from large enrichment plants contaminated primarily with uranium. Representative waste characteristics were selected from existing cleanup waste profiles from the Oak Ridge Gaseous Diffusion Plant (East Tennessee Technology Park) where decommissioning a similar site is progressing and is scheduled to be complete by 2010. Four representative profiles were judged to be appropriate and applied proportionally to the projected waste volumes at Portsmouth and Paducah.

Los Alamos National Laboratory (LANL) is operated by the National Nuclear Security Administration and has onsite disposal facilities for its LLW. The EM program at LANL is currently characterizing waste historically managed as TRU waste. A portion of this waste when characterized does not meet the definition of TRU waste and cannot be disposed on site at LANL because MLLW disposal is not permitted. Projected MLLW that falls between 10 and 100 nanocuries per gram is a candidate for the Hanford forecast after closure of the NTS MLLW facility. The forecast volume of LANL MLLW between 2010 and 2020, when all TRU characterization work is expected to be complete, is 400 cubic meters. As a result of discussions with waste managers at LANL, radiological profiles were obtained for inorganic cemented sludge from an on-site water treatment plant. No chemical profile was available for the LANL sludge, so comparable INL chemical characterization data for two batches of MLLW sludge was obtained and judged as representative.

Savannah River Site (SRS) utilizes both onsite and commercial disposal facilities for its LLW. No LLW is forecast to be shipped to Hanford. In discussions with waste managers at SRS, a waste stream with 100 cubic meters of MLLW was identified as a candidate for disposal at Hanford in 2010-2012 following the NTS MLLW facility closure. SRS waste managers provided a radiological profile for the MLLW which contains some Pu-238 and Pu-239 constituents. No chemical characteristics were available, so the chemical profile for Rocky Flats debris MLLW waste was judged as representative. To accommodate future, as yet unplanned MLLW generation at SRS, another MLLW stream is included in the forecast with 6,330 cubic meters between 2010 and 2035. The same Rocky Flats debris waste profile was judged as representative for the radiological and hazardous chemical constituents.

Office of Science Waste

The Office of Science (SC) is responsible for ongoing operations at eight DOE laboratory sites. Historically, the SC laboratories shipped LLW to Hanford for disposal, but were prevented from doing so recently due to legal impediments. SC waste managers indicated most waste generated from operations is now planned for NTS or commercial disposal.

Three SC-operated laboratories: Argonne National Laboratory (ANL), Brookhaven National Laboratory (BNL), and Oak Ridge National Laboratory (ORNL) forecasted future waste that could be disposed at Hanford. ANL forecasted 100 cubic meters of LLW from decommissioning of facilities between 2011 and 2018. Radiological characteristics of this future LLW volume was not available from waste managers, so the Capacity Report complex wide profile was judged to be appropriate due to the variety of nuclear applications at ANL. BNL waste managers identified two LLW steams totaling 70 cubic meters with corresponding radioactive waste profiles. The streams include sealed sources (disposed between 2010 and 2015) and decommissioning waste from the Brookhaven Linear Isotope Production facility between 2030 and 2035.

SC waste managers estimated 730 cubic meters of LLW between 2010 and 2035 timeframe from ongoing operations in Oak Ridge. Radiological characteristics of this future LLW volume was not available from waste managers, so the Capacity Report complex wide profile was judged to be appropriate due to the variety of nuclear applications at ORNL. In addition to operations waste, there are a number of facilities at the Oak Ridge Reservation that have not yet been scheduled for decommissioning by SC, EM, or NNSA. The scope of the work and resulting waste is uncertain, but additional waste is likely after 2010. Some of this waste will be disposed off site at DOE regional disposal facilities and commercial facilities, consistent with the Oak Ridge experience to date. The forecast includes a LLW stream of 6,500 cubic meters and a MLLW stream of 6,330 cubic meters for future waste from Oak Ridge. For LLW, the Capacity Report complex-wide profile was judged appropriate due to the variety of waste from cleanup. For MLLW, the Rocky Flats debris stream also applied at West Valley, INL, and SRS forecasts was judged appropriate for the variety of waste expected from cleanup.

Naval Reactors

Naval Reactors (a part of NNSA) produces LLW as a result of operations of various shipyards and laboratories across the nation. In addition to Naval Reactors LLW already disposed at Hanford, a new Naval Reactors waste stream is included in the forecast for analytical purposes. As mentioned previously, LLW generated at the Naval Reactors Facility (NRF) at INL is currently disposed onsite at INL, but the LLW disposal facility used by Naval Reactors at INL may close in the near future as a result of the site cleanup agreement. Discussions with Naval Reactors waste managers resulted in a projected volume of 22,000 cubic meters of routine LLW from the NRF at INL that is included in the Hanford forecast between 2008 and 2046. A radiological profile has been provided by Naval Reactors for this LLW.

CONCLUSIONS

DOE used available waste volume projections to frame the forecast for the *Hanford Tank Closure and Waste Management EIS.* The analysis focused on ongoing operations and post-2010 cleanup activities that will generate wastes requiring or utilizing DOE regional disposal facilities. After contacting waste managers, expert judgment was applied to waste projection and characteristics data to develop a waste forecast for the new Hanford EIS. Considerable uncertainty remains in the waste projections, due to limited planning data and the uncertainties in the cleanup program scope from where most waste volumes arise. However, conservative assumptions were employed to support EIS analyses. This analysis confirms the need to maintain the waste volumes included in the record of decision from the 2004 *Hanford Solid Waste EIS* (62,000 cubic meters for LLW and

20,000 cubic meters of MLLW) and provides assumptions for modeling purposes, including offsite sources, timing, and sources of radiological/chemical characteristics.

The process described above resulted in estimated waste volumes, waste characteristics, final waste forms, and shipment dates for the waste generated by other DOE sites that would be shipped to Hanford for disposal. Radioactivity estimates (measured in curies) for over 110 isotopes and chemical estimates (measured in kilograms) for 41 chemical compounds also were developed.

As stated above, the *Analysis of Offsite-Generated Waste Projections, "Tank Closure and Waste Management Environmental Impact Statement for the Hanford Site"* (DOE 2006b) includes estimates for wastes generated at the West Valley Demonstration Project that may require disposal at Hanford. The estimates were 12,000 cubic meters (15,700 cubic yards) of LLW and 500 cubic meters (650 cubic yards) of MLLW. Since then, DOE has prepared the *Final Environmental Impact Statement for Decommissioning and/or Long-Term Stewardship at the West Valley Demonstration Project and Western New York Nuclear Service Center* (DOE and NYSERDA 2010), which slightly revised these estimates. Under the Sitewide Removal Alternative, which is the alternative that would result in the largest waste volume requiring offsite disposal, the revised estimated volumes are approximately 13,710 cubic meters (17,930 cubic yards) of LLW and 510 cubic meters (670 cubic yards) of MLLW (Burandt 2008). Due to the high degree of uncertainty involved in estimating waste shipments to Hanford after 2010, the current estimates of 12,000 cubic meters (15,700 cubic yards) of LLW and 500 cubic meters (650 cubic yards) of MLLW are considered reasonable estimates and appropriate for analysis purposes in this *TC & WM EIS*. Additionally, since the above analysis was performed, DOE has initiated planning for a new MLLW disposal facility at the Nevada National Security Site, formerly the Nevada Test Site, to continue to provide two DOE residual disposal facilities consistent with the *Final Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste* (DOE 1997) and the LLW and MLLW Record of Decision (65 FR 10061).

Table D–86 summarizes the DOE sites, waste form characteristics, and volumes and years of shipment projected for waste shipments from other DOE sites to Hanford. Table D–87 summarizes the 9 radioactive COPC inventories associated with the potential wastes from each DOE site. Table D–88 summarizes the 15 chemical COPC inventories associated with the potential wastes from each DOE site.

Table D–86. Offsite Waste Projection Characteristics by U.S. Department of Energy Site

DOE Site and Waste Category	Waste Category[a]	Final Waste Form	Waste-Form Volume (cubic meters)	Year of Shipment	
				Start	End
West Valley Demonstration Project					
WV-Class A	LLW-Class A	Grouted	11,000	2022	2042
WV-Class B	LLW-Class B	Grouted	200	2022	2042
WV-Class C	LLW-Class C	Grouted	800	2022	2042
Idaho National Laboratory					
RH-LLW	RH-LLW	Resins	30	2022	2022
RH-LLW	RH-LLW	Resins	200	2023	2027
RH-LLW	RH-LLW	Resins	200	2030	2032
RH-LLW	RH-LLW	Resins	200	2033	2037
RH-LLW	RH-LLW	Resins	200	2038	2042
RH-LLW	RH-LLW	Resins	270	2042	2047
Brookhaven National Laboratory					
BNL sealed sources	LLW	Sealed sources	5	2022	2027
BNL-2 – Brookhaven Linear Isotope Production Facility	LLW	Encapsulated activated metals, concrete debris, lead (solid)	65	2042	2047
Oak Ridge National Laboratory – LLW	LLW	Grout	730	2022	2047
Argonne National Laboratory – LLW	LLW	Grout	100	2023	2030
Naval Reactors					
LLW – Bettis, Idaho	LLW	Solid	22,000	2022	2046
Paducah					
LLW No. 1	LLW	Solids (metal)	845	2027	2047
LLW No. 2	LLW	Solids (metal)	195	2027	2047
LLW No. 3	LLW	Solids (metal)	1,690	2027	2047
LLW No. 4	LLW	Solids (metal)	3,770	2027	2047
Portsmouth					
LLW No. 1	LLW	Solids (metal)	845	2022	2032
LLW No. 2	LLW	Solids (metal)	195	2022	2032
LLW No. 3	LLW	Solids (metal)	1,690	2022	2032
LLW No. 4	LLW	Solids (metal)	3,770	2022	2032
Idaho National Laboratory – RH-LLW[b]	RH-LLW	Resins	0	N/A	N/A
Oak Ridge Reservation – LLW	LLW	Grout	6,500	2022	2047
Total LLW			**55,500**		

Table D–86. Offsite Waste Projection Characteristics by U.S. Department of Energy Site *(continued)*

DOE Site and Waste Category	Waste Category[a]	Final Waste Form	Waste-Form Volume (cubic meters)	Year of Shipment	
				Start	End
West Valley Demonstration Project – MLLW	MLLW	Debris	500	2022	2042
Los Alamos National Laboratory – MLLW	MLLW	Cemented sludges	400	2022	2032
Savannah River Site – MLLW	RH-MLLW	Grout	100	2022	2024
Idaho National Laboratory					
CH-MLLW	CH-MLLW	Debris	1	2022	2022
CH-MLLW	CH-MLLW	Debris	2	2023	2028
CH-MLLW	CH-MLLW	Debris	2	2028	2033
CH-MLLW	CH-MLLW	Debris	2	2033	2037
CH-MLLW	CH-MLLW	Debris	2	2038	2042
CH-MLLW	CH-MLLW	Debris	1	2042	2047
Idaho National Laboratory – MLLW	MLLW-D&D	Debris	6,330	2022	2047
Savannah River Site – MLLW	MLLW-D&D	Debris	6,330	2022	2047
Oak Ridge Reservation – MLLW	MLLW-D&D	Debris	6,330	2022	2047
Total MLLW			**20,000**		

[a] Per *Hanford Site Solid Waste Acceptance Criteria*, Rev. 12 (Fluor Hanford 2005b).

[b] As part of a reevaluation of the inventories within the Waste Management alternatives, the Idaho National Laboratory RH-LLW resins waste, with a volume of 6,500 cubic meters, was not modeled in the groundwater analysis in this environmental impact statement. Such an action by DOE could be the result of a number of changes at the Hanford site, such as revisions to the Integrated Disposal Facility waste acceptance criteria.

Note: To convert cubic meters to cubic yards, multiply by 1.308.

Key: BNL=Brookhaven National Laboratory; CH=contact-handled; D&D=decontamination and decommissioning; DOE=U.S. Department of Energy; LLW=low-level radioactive waste; MLLW=mixed low-level radioactive waste; N/A=not applicable; RH=remote-handled; WV=West Valley.

Source: SAIC 2011.

Table D–87. Summary of Offsite Radioactive Constituents of Potential Concern Inventories by U.S. Department of Energy Site

DOE Site and Waste Category	Radionuclide Inventory (curies)								
	Iodine-129	**Cesium-137**	**Carbon-14**	**Hydrogen-3 (Tritium)**	**Uranium-233, -234, -235, -238**	**Neptunium-237**	**Plutonium-239, -240**	**Strontium-90**	**Technetium-99**
West Valley Demonstration Project – LLW	3.04×10^{-2}	3.71×10^{5}	2.90×10^{1}	3.42×10^{4}	3.39×10^{1}	1.22×10^{-2}	1.09×10^{1}	4.28×10^{5}	2.99
INL – RH-LLW	2.20	2.20×10^{3}	8.80×10^{2}	5.50×10^{2}	NR	NR	7.40	8.25×10^{2}	5.72×10^{1}
Brookhaven National Laboratory – LLW	NR	9.20×10^{3}	NR	2.44×10^{-4}	NR	NR	2.44×10^{-4}	4.04	NR
Oak Ridge National Laboratory – LLW	1.85×10^{-3}	2.26×10^{4}	1.77	2.08×10^{3}	2.06	7.45×10^{-4}	6.64×10^{-1}	2.61×10^{4}	1.82×10^{-1}
Argonne National Laboratory – LLW	2.53×10^{-4}	3.09×10^{3}	2.42×10^{-1}	2.85×10^{2}	2.83×10^{-1}	1.02×10^{-4}	9.10×10^{-2}	3.57×10^{3}	2.49×10^{-2}
Naval Reactors – LLW	NR	3.85×10^{1}	1.46	3.26	4.73×10^{-4}	NR	5.06×10^{-2}	2.06×10^{1}	1.16
Paducah – LLW	NR	NR	NR	NR	4.63	1.79×10^{-2}	2.31×10^{-2}	NR	6.95×10^{2}
Portsmouth – LLW	NR	NR	NR	NR	4.63	1.79×10^{-2}	2.31×10^{-2}	NR	6.95×10^{2}
INL – RH-LLW[a]	0	0	0	0	NR	NR	0	0	0
Oak Ridge Reservation – LLW	1.64×10^{-2}	2.01×10^{5}	1.57×10^{1}	1.85×10^{4}	1.84×10^{1}	6.63×10^{-3}	5.92	2.32×10^{5}	1.62
Total LLW	**2.25**	**6.09×10^{5}**	**9.28×10^{2}**	**5.56×10^{4}**	**6.39×10^{1}**	**5.55×10^{-2}**	**2.51×10^{1}**	**6.91×10^{5}**	**1.45×10^{3}**
West Valley Demonstration Project – MLLW	NR	NR	NR	NR	8.00	NR	1.14×10^{1}	NR	NR
Los Alamos National Laboratory – MLLW	NR	1.28×10^{-2}	NR	NR	1.66×10^{-1}	1.28×10^{-2}	1.28	1.28×10^{-2}	NR
Savannah River Site – RH-MLLW	NR	NR	NR	NR	NR	2.05×10^{-5}	1.16×10^{1}	NR	NR
INL – RH-MLLW	1.60×10^{-2}	1.60×10^{4}	4.80×10^{-2}	8.00×10^{1}	1.12	8.64×10^{-1}	1.90×10^{1}	1.60×10^{4}	3.04
INL – MLLW	NR	NR	NR	NR	1.01×10^{2}	NR	1.44×10^{2}	NR	NR
Savannah River Site – MLLW	NR	NR	NR	NR	1.01×10^{2}	NR	1.44×10^{2}	NR	NR
Oak Ridge Reservation – MLLW	NR	NR	NR	NR	1.01×10^{2}	NR	1.44×10^{2}	NR	NR
Total MLLW	**1.60×10^{-2}**	**1.60×10^{4}**	**4.80×10^{-2}**	**8.00×10^{1}**	**3.13×10^{2}**	**8.77×10^{-1}**	**4.76×10^{2}**	**1.60×10^{4}**	**3.04**
Total LLW and MLLW	**2.26**	**6.25×10^{5}**	**9.28×10^{2}**	**5.57×10^{4}**	**3.77×10^{2}**	**9.32×10^{-1}**	**5.01×10^{2}**	**7.07×10^{5}**	**1.46×10^{3}**

[a] As part of a reevaluation of the inventories within the Waste Management alternatives, the INL RH-LLW resins waste, with the following inventory, was not modeled in the groundwater analysis in this environmental impact statement: iodine-129=1.30×10^{1} curies; cesium-137=1.30×10^{4} curies; carbon-14=5.20×10^{3} curies; hydrogen-3 (tritium)=3.25×10^{3} curies; plutonium-239, -240=4.37×10^{1} curies; strontium-90=4.88×10^{3} curies; technetium-99=3.38×10^{2} curies. Such an action by DOE could be the result of a number of changes at the Hanford site, such as revisions to the Integrated Disposal Facility waste acceptance criteria.

Key: DOE=U.S. Department of Energy; INL=Idaho National Laboratory; LLW=low-level radioactive waste; MLLW=mixed low-level radioactive waste; NR=not reported; RH=remote-handled.

Source: SAIC 2011.

Table D–88. Summary of Offsite Chemical Constituents of Potential Concern Inventories by U.S. Department of Energy Site

DOE Site and Waste Category	Chemical Inventory (kilograms)														
	Arsenic (As)	**Boron (B)**	**Cadmium (Cd)**	**Chromium (Cr)**	**Fluorine (Fl)**	**Lead (Pb)**	**Manganese (Mn)**	**Mercury (Hg)**	**Molybdenum (Mo)**	**Nickel (Ni)**	**Nitrate (NO_3)**	**PCBs**	**Silver (Ag)**	**Strontium (Sr)**	**Total Uranium (U)**
WVDP – LLW	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Idaho National Laboratory – RH-LLW	5.06×10^{-1}	NR	3.30×10^{-3}	2.24	NR	NR	NR	NR	NR	NR	NR	NR	6.93×10^{-3}	NR	NR
Brookhaven National Laboratory – LLW	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Oak Ridge National Laboratory – LLW	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Argonne National Laboratory – LLW	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Naval Reactors – LLW	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Paducah – LLW	3.77×10^{-3}	NR	5.95×10^{-2}	2.15	NR	5.26×10^{-1}	NR	NR	NR	NR	NR	NR	3.77×10^{-3}	NR	NR
Portsmouth – LLW	3.77×10^{-3}	NR	5.95×10^{-2}	2.15	NR	5.26×10^{-1}	NR	NR	NR	NR	NR	NR	3.77×10^{-3}	NR	NR
Idaho National Laboratory – RH-LLW[a]	0	NR	0	0	NR	NR	NR	NR	NR	NR	NR	NR	0	NR	NR
Oak Ridge Reservation – LLW	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Total LLW	**5.14×10^{-1}**	**NR**	**1.22×10^{-1}**	**6.55**	**NR**	**1.05**	**NR**	**NR**	**NR**	**NR**	**NR**	**NR**	**1.45×10^{-2}**	**NR**	**NR**

Table D–88. Summary of Offsite Chemical Constituents of Potential Concern Inventories by U.S. Department of Energy Site *(continued)*

DOE Site and Waste Category	Chemical Inventory (kilograms)														
	Arsenic (As)	**Boron (B)**	**Cadmium (Cd)**	**Chromium (Cr)**	**Fluorine (Fl)**	**Lead (Pb)**	**Manganese (Mn)**	**Mercury (Hg)**	**Molybdenum (Mo)**	**Nickel (Ni)**	**Nitrate (NO_3)**	**PCBs**	**Silver (Ag)**	**Strontium (Sr)**	**Total Uranium (U)**
WVDP – MLLW	4.67×10^{-2}	NR	4.34×10^{-2}	1.68×10^{-2}	NR	1.49×10^{-2}	NR	8.70×10^{-3}	NR	7.75×10^{-1}	NR	NR	5.15×10^{-2}	NR	NR
Los Alamos National Laboratory – MLLW	2.19	NR	3.13	6.43×10^{1}	NR	1.34×10^{2}	NR	8.04	NR	NR	NR	NR	1.83×10^{1}	NR	NR
Savannah River Site – RH-MLLW	9.34×10^{-3}	NR	8.68×10^{-3}	3.35×10^{-3}	NR	2.97×10^{-3}	NR	1.74×10^{-3}	NR	1.55×10^{-1}	NR	NR	1.03×10^{-2}	NR	NR
Idaho National Laboratory – RH-MLLW	5.50×10^{-1}	NR	1.26×10^{2}	9.00	NR	4.41	NR	2.08×10^{1}	NR	NR	NR	NR	2.70	NR	NR
Idaho National Laboratory – MLLW	5.91×10^{-1}	NR	5.49×10^{-1}	2.12×10^{-1}	NR	1.88×10^{-1}	NR	1.10×10^{-1}	NR	9.81	NR	NR	6.52×10^{-1}	NR	NR
Savannah River Site – MLLW	5.91×10^{-1}	NR	5.49×10^{-1}	2.12×10^{-1}	NR	1.88×10^{-1}	NR	1.10×10^{-1}	NR	9.81	NR	NR	6.52×10^{-1}	NR	NR
Oak Ridge Reservation – MLLW	5.91×10^{-1}	NR	5.49×10^{-1}	2.12×10^{-1}	NR	1.88×10^{-1}	NR	1.10×10^{-1}	NR	9.81	NR	NR	6.52×10^{-1}	NR	NR
Total MLLW	**4.57**	**NR**	**1.31×10^{2}**	**7.39×10^{1}**	**NR**	**1.39×10^{2}**	**NR**	**2.91×10^{1}**	**NR**	**3.04×10^{1}**	**NR**	**NR**	**2.30×10^{1}**	**NR**	**NR**
Total LLW and MLLW	**5.09**	**NR**	**1.31×10^{2}**	**8.05×10^{1}**	**NR**	**1.40×10^{2}**	**NR**	**2.91×10^{1}**	**NR**	**3.04×10^{1}**	**NR**	**NR**	**2.31×10^{1}**	**NR**	**NR**

[a] As part of a reevaluation of the inventories within the Waste Management alternatives, the Idaho National Laboratory RH-LLW resins waste, with the following inventory, was not modeled in the groundwater analysis in this environmental impact statement: arsenic=2.99 kilograms; cadmium=1.95×10^{-2} kilograms; chromium=1.33×10^{1} kilograms; silver=4.10×10^{-2} kilograms. Such an action by DOE could be the result of a number of changes at the Hanford site, such as revisions to the IDF waste acceptance criteria.

Note: To convert kilograms to pounds, multiply by 2.2046.

Key: DOE=U.S. Department of Energy; LLW=low-level radioactive waste; MLLW=mixed low-level radioactive waste; NR=not reported; PCB=polychlorinated biphenyl; RH=remote-handled; WVDP=West Valley Demonstration Project.

Source: SAIC 2011.

D.4 REFERENCES

Agnew, S.F., J. Boyer, R.A. Corbin, T.B. Duran, J.R. FitzPatrick, K.A. Jurgensen, T.P. Ortiz, and B.L. Young, 1997, *Hanford Tank Chemical and Radionuclide Inventories: HDW Model Rev. 4*, LA-UR-96-3860, Los Alamos National Laboratory, Chemical Science and Technology Division, Los Alamos, New Mexico, January.

Barcot, R.A., 2005, *Solid Waste Integrated Forecast Technical (SWIFT) Report, FY2006–FY2035, 2006.0, Volume 1*, HNF-EP-0918, Rev. 16, Fluor Hanford, Inc., Richland, Washington, December.

Barnett, D.B., G.W. Gee, M.D. Sweeney, M.D. Johnson, V.F. Medina, D.P. Mendoza, B.G. Fritz et al., 2003, *Results of Performance Evaluation Testing of Electrical Leak-Detection Methods at the Hanford Site Mock Tank – FY 2002–2003*, PNNL-14192, Pacific Northwest National Laboratory, Richland, Washington, February.

BNI (Bechtel National, Inc.), 2002, *Revised Severity Level Calculations for the LAW Facility*, 24590-LAW-Z0C-W14T-00003, Rev. B, Richland, Washington, January 26.

Burandt, M., 2008, U.S. Department of Energy, Office of River Protection, Richland, Washington, personal communication (email) to L.B. Gannon, Science Applications International Corporation, Germantown, Maryland, "Please Review the WVDP Offsite Waste Volume Paragraph Revision," October 28.

CEES (Columbia Energy & Environmental Services, Inc.), 2006, *FFTF Radioactive and Hazardous Materials Inventory*, 6734-FFTF-Inventory-002, Rev. 1, Richland, Washington, July.

CEES (Columbia Energy & Environmental Services, Inc.), 2007, *Revision of PCAL 17284-2 Mass Balance*, WT-ST-056, Rev. 2, Richland, Washington, March 14.

CEES (Columbia Energy & Environmental Services, Inc.), 2010, *Curie Distribution for Alternatives 1, 2A, 2B, 3A, 3B, 3C, 4, 5, 6A, 6B and 6C*, WT-ST-042, Rev. 10, Richland, Washington, October 27.

CEES (Columbia Energy & Environmental Services, Inc.), 2011, *Best Basis Inventory (BBI) Global Changes*, Emerging Data Form 341, Richland, Washington, March 28.

CH2M HILL (CH2M HILL Hanford Group, Inc.), 2002, *Field Investigation Report for Waste Management Area S-SX*, RPP-7884, Rev. 0, Richland, Washington, January 31.

Chapin, D.H., 2007, U.S. Department of Energy, Richland Operations Office, Richland, Washington, personal communication (email) to C.L. Johnson, Science Applications International Corporation, Germantown, Maryland, "DOE-RL/FFTF Project Response to SAIC (Charlotte Johnson) Re: Status of FFTF Deactivation," Attachment, "Status of FFTF Project Deactivation (June 2007)," June 6.

Connelly, M.P., 2007, *Field Investigation Report for Waste Management Area U*, RPP-35485, Rev. 0, CH2M HILL Hanford Group, Inc., Richland, Washington, December 18.

Connelly, M.P., 2008, *Field Investigation Report for Waste Management Areas C and A-AX*, RPP-35484, Rev. 1, CH2M HILL Hanford Group, Inc., Richland, Washington, January 29.

Corbin, R.A., B.C. Simpson, M.J. Anderson, W.F. Danielson III, J.G. Field, T.E. Jones, and C.T. Kincaid, 2005, *Hanford Soil Inventory Model, Rev. 1*, RPP-26744, Rev. 0, CH2M HILL Hanford Group, Inc., Richland, Washington, September.

Croff, A.G., 1980, *ORIGEN2—A Revised and Updated Version of the Oak Ridge Isotope Generation and Depletion Code*, ORNL-5621, Oak Ridge National Laboratory, Oak Ridge, Tennessee, July.

DOE (U.S. Department of Energy), 1995, *Environmental Assessment, Shutdown of the Fast Flux Test Facility, Hanford Site, Richland, Washington*, DOE/EA-0993, Richland Operations Office, Richland, Washington, May.

DOE (U.S. Department of Energy), 1997, *Final Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste*, DOE/EIS-0200-F, Office of Environmental Management, Washington, D.C., May.

DOE (U.S. Department of Energy), 2003a, *Environmental Impact Statement for Retrieval, Treatment, and Disposal of Tank Waste and Closure of Single-Shell Tanks at the Hanford Site, Richland, WA: Inventory and Source Term Data Package*, DOE/ORP-2003-02, Rev. 0, Office of River Protection, Richland, Washington, April 17.

DOE (U.S. Department of Energy), 2003b, *Environmental Impact Statement for Retrieval, Treatment, and Disposal of Tank Waste and Closure of Single-Shell Tanks at the Hanford Site, Richland, WA: Waste Retrieval and Storage Data Package*, DOE/ORP-2003-06, Rev. 0, Office of River Protection, Richland, Washington, April 17.

DOE (U.S. Department of Energy), 2005, *Technical Guidance Document for Tank Closure Environmental Impact Statement Vadose Zone and Groundwater Revised Analyses*, Final Rev. 0, Office of River Protection, Richland, Washington, March 25.

DOE (U.S. Department of Energy), 2006a, *Environmental Assessment, Sodium Residuals Reaction/Removal and Other Deactivation Work Activities, Fast Flux Test Facility (FFTF) Project, Hanford Site, Richland, Washington*, DOE/EA-1547F, Richland Operations Office, Richland, Washington, March.

DOE (U.S. Department of Energy), 2006b, *Analysis of Offsite-Generated Waste Projections, "Tank Closure and Waste Management Environmental Impact Statement for the Hanford Site,"* Office of Environmental Management, Office of Disposal Operations, July 13.

DOE and Ecology (U.S. Department of Energy, Richland Operations Office, Richland, Washington, and Washington State Department of Ecology, Olympia, Washington), 1996, *Tank Waste Remediation System, Hanford Site, Richland, Washington, Final Environmental Impact Statement*, DOE/EIS-0189, August.

DOE and NYSERDA (U.S. Department of Energy and New York State Energy Research and Development Authority), 2010, *Final Environmental Impact Statement for Decommissioning and/or Long-Term Stewardship at the West Valley Demonstration Project and Western New York Nuclear Service Center*, DOE/EIS-0226, West Valley Demonstration Project, West Valley, New York, January.

Ecology, EPA, and DOE (Washington State Department of Ecology, Olympia, Washington; U.S. Environmental Protection Agency, Washington, D.C.; and U.S. Department of Energy, Richland, Washington), 1989, Hanford Federal Facility Agreement and Consent Order, 89-10, as amended, accessed through http://www.hanford.gov/tpa/tpahome.htm, May 15.

Field, J.G., and K.M. Bowen, 2003, *Best-Basis Inventory Process Requirements*, RPP-7625, Rev. 4, CH2M HILL Hanford Group, Inc., Richland, Washington, October.

Fluor Hanford (Fluor Hanford, Inc.), 2005a, *Technical Information Document for the Fast Flux Test Facility Closure Project Environmental Impact Statement*, FFTF-18346, Rev. 1, Richland, Washington, April.

Fluor Hanford (Fluor Hanford, Inc.), 2005b, *Hanford Site Solid Waste Acceptance Criteria*, HNF-EP-0063, Rev. 12, Richland, Washington, July 6.

Hanlon, B.M., 2003, *Waste Tank Summary Report for Month Ending December 31, 2002*, HNF-EP-0182, Rev. 177, CH2M HILL Hanford Group, Inc., Richland, Washington, February.

Hanson, C.E., 2003, *Tank S-112 Saltcake Waste Retrieval Demonstration Project Leak Detection, Monitoring, and Mitigation Strategy*, RPP-10413, Rev. 0, CH2M HILL Hanford Group, Inc., Richland, Washington, February.

Hedges, J.A., 2008, Washington State Department of Ecology, Richland, Washington, personal communication (letter) to S.J. Olinger, U.S. Department of Energy, Office of River Protection, Richland, Washington, D.A. Brockman, U.S. Department of Energy, Richland Operations Office, Richland, Washington, and W.S. Elkins, Bechtel National, Inc., Richland, Washington, "Draft Waste Treatment and Immobilization Plant (WTP) Dangerous Waste Permit," October 15.

Jones, T.E., B.C. Simpson, M.I. Wood, and R.A. Corbin, 2001, *Preliminary Inventory Estimates for Single-Shell Tank Leaks in B, BX, and BY Tank Farms*, RPP-7389, Rev. 0, CH2M HILL Hanford Group, Inc., Richland, Washington, February.

Kidd, C.C., 2005, *Activation of the FFTF Biological Shield Wall*, FFTF-26790, Rev. 0, Fluor Hanford, Inc., Richland, Washington, October.

Kirkbride, R.A., G.K. Allen, B.A. Higley, T.M. Hohl, S.L. Lambert, R.M. Orme, D.E. Place et al., 2002, *Tank Farm Contractor Operation and Utilization Plan*, Vol. I, HNF-SD-WM-SP-012, Rev. 4, U.S. Department of Energy, Office of River Protection, Richland, Washington, September.

Mahoney, L.A., Z.I. Antoniak, J.M. Bates, and M.E. Dahl, 1999, *Retained Gas Sampling Results for the Flammable Gas Program*, PNNL-13000, Rev. 0, Pacific Northwest National Laboratory, Richland, Washington, November.

Myers, D.A., 2005, *Field Investigation Report for Waste Management Areas T and TX-TY*, RPP-23752, Rev. 0, CH2M HILL Hanford Group, Inc., Richland, Washington, June.

SAIC (Science Applications International Corporation), 2010a, *Tank Closure Alternatives, Scaled Data Sets to Support the "Tank Closure and Waste Management Environmental Impact Statement for the Hanford Site, Richland, Washington,"* Germantown, Maryland, June 3, August 26, and December 10.

SAIC (Science Applications International Corporation), 2010b, *Fast Flux Test Facility Alternatives, Scaled Data Sets to Support the "Tank Closure and Waste Management Environmental Impact Statement for the Hanford Site, Richland, Washington,"* Germantown, Maryland, November 8.

SAIC (Science Applications International Corporation), 2010c, *Waste Management Alternatives, Scaled Data Sets to Support the "Tank Closure and Waste Management Environmental Impact Statement for the Hanford Site, Richland, Washington,"* Germantown, Maryland, June 3.

SAIC (Science Applications International Corporation), 2011, *Waste Inventories Reference Mapping*, Germantown, Maryland, December 2.

Simpson, B.C., R.A. Corbin, and S.F. Agnew, 2001, *Groundwater/Vadose Zone Integration Project: Hanford Soil Inventory Model*, BHI-01496, Rev. 0, Bechtel Hanford, Inc., Richland, Washington, March.

Simpson, B.C., C. DeFigh-Price, and D.L. Banning, 1999, *Technical Basis for the Determination That Current Characterization Data and Processes Are Sufficient to Ensure Safe Storage and to Design Waste Disposal Facilities*, HNF-4232, Rev. 0, Lockheed Martin Hanford Corporation, Richland, Washington, June.

Whyatt, G.A., J.W. Shade, and G.E. Stegen, 1996, *Volatility and Entrainment of Feed Components and Product Glass Characteristics During Pilot-Scale Vitrification of Simulated Hanford Site Low-Level Waste*, WHC-SA-3093-FP, Westinghouse Hanford Company, Richland, Washington, April.

York, M.T., 2005, Fluor Hanford, Inc., Richland, Washington, personal communication (email) to T.W. Ferns, U.S. Department of Energy, Richland Operations Office, Richland, Washington, "Special Components," March 16.

Zamecnik, J.R., and C.L. Crawford, 2003, *Offgas Emissions from the Vitrification of Hanford Envelope C Low Activity Waste*, WSRC-MS-2003-00072, Rev. 0, Westinghouse Savannah River Company, LLC, Aiken, South Carolina, January 14.

Federal Register

65 FR 10061, U.S. Department of Energy, 2000, "Record of Decision for the Department of Energy's Waste Management Program: Treatment and Disposal of Low-Level Waste and Mixed Low-Level Waste; Amendment of the Record of Decision for the Nevada Test Site," February 25.

69 FR 39449, U.S. Department of Energy, 2004, "Record of Decision for the Solid Waste Program, Hanford Site, Richland, WA: Storage and Treatment of Low-Level Waste and Mixed Low-Level Waste; Disposal of Low-Level Waste and Mixed Low-Level Waste, and Storage, Processing, and Certification of Transuranic Waste for Shipment to the Waste Isolation Pilot Plant," June 30.

71 FR 5655, U.S. Department of Energy, 2006, "Notice of Intent to Prepare the Tank Closure and Waste Management Environmental Impact Statement for the Hanford Site, Richland, WA," February 2.